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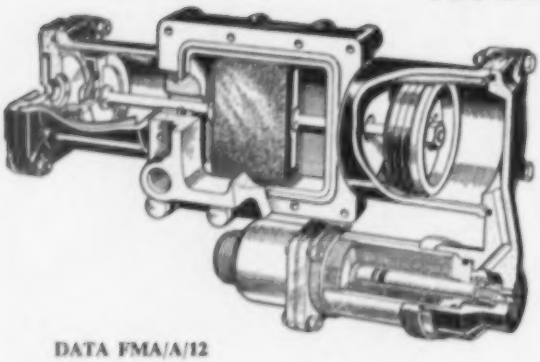

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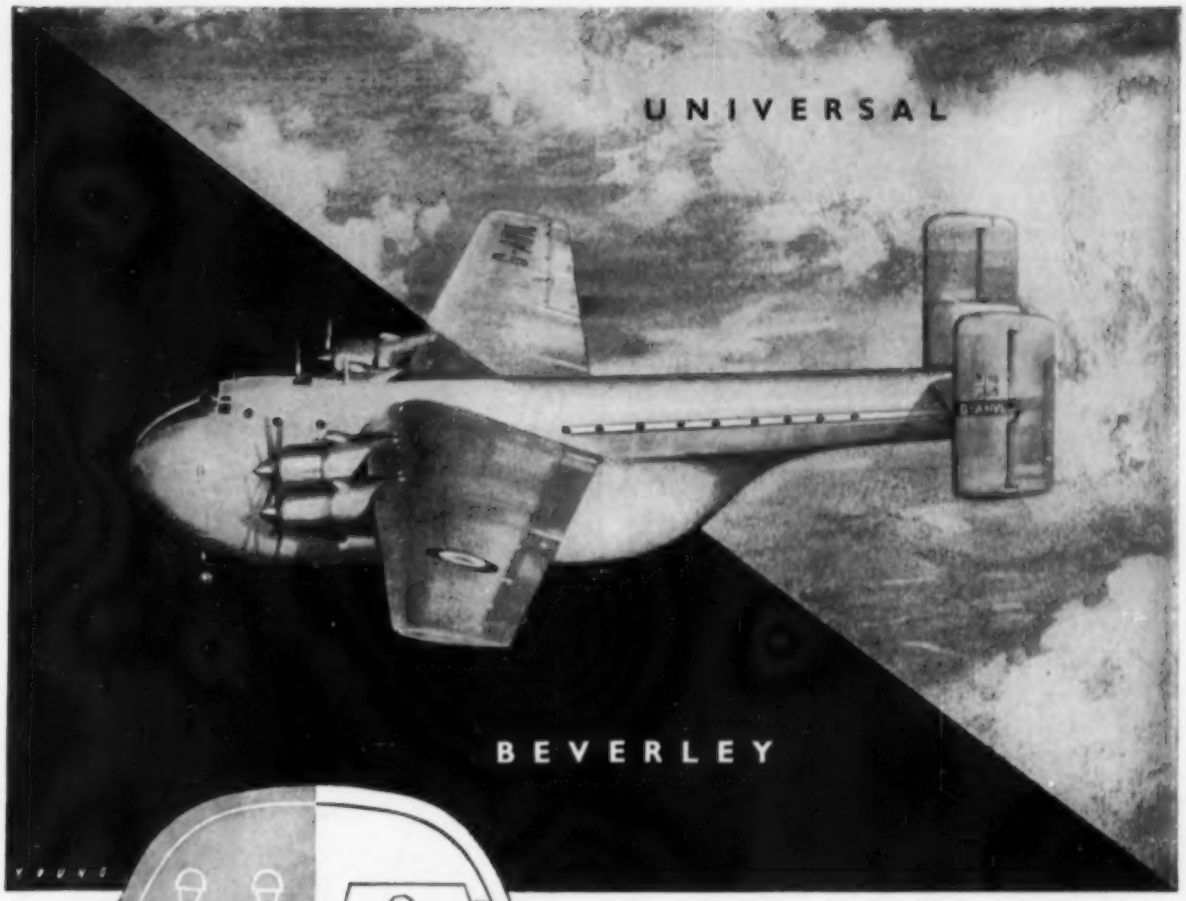

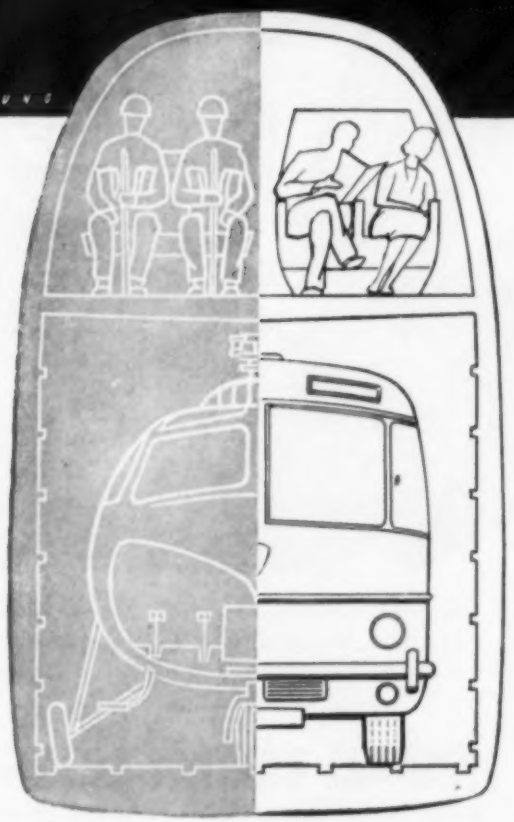

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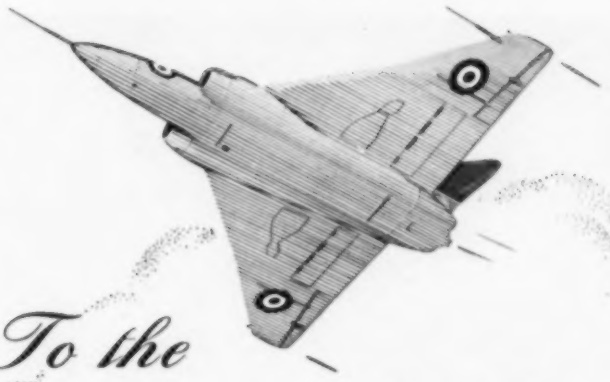

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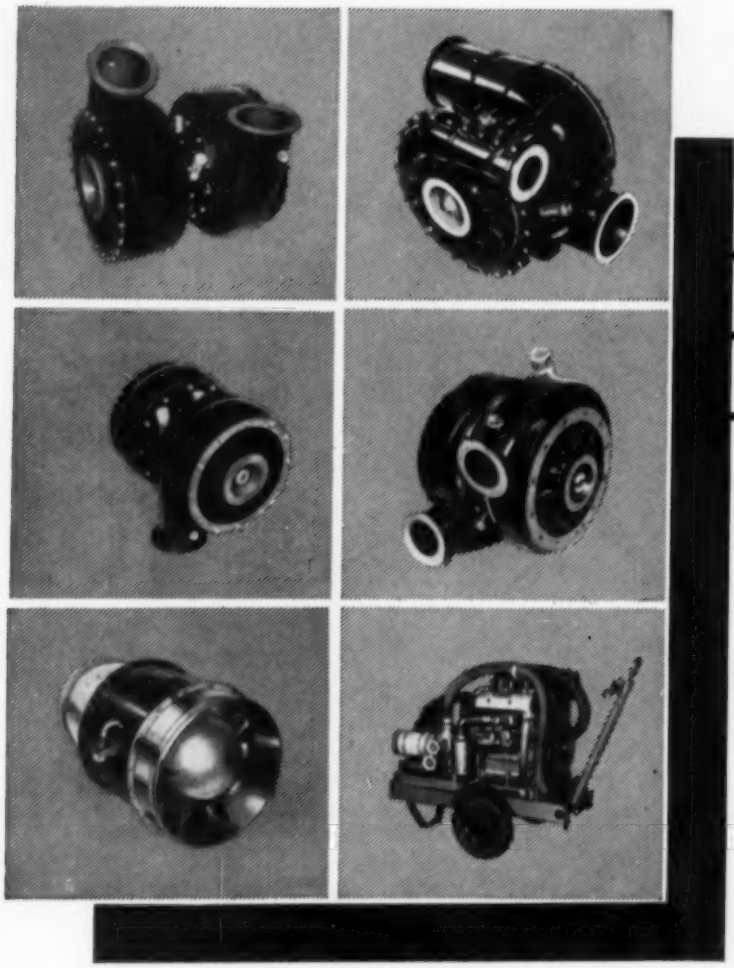

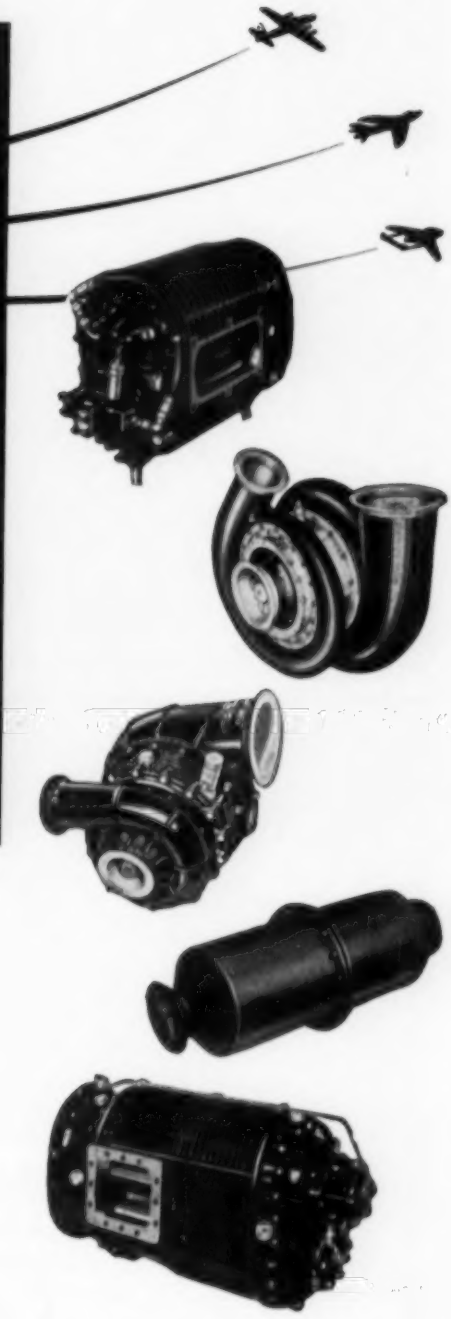

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163 *B.O.A.C. photograph*

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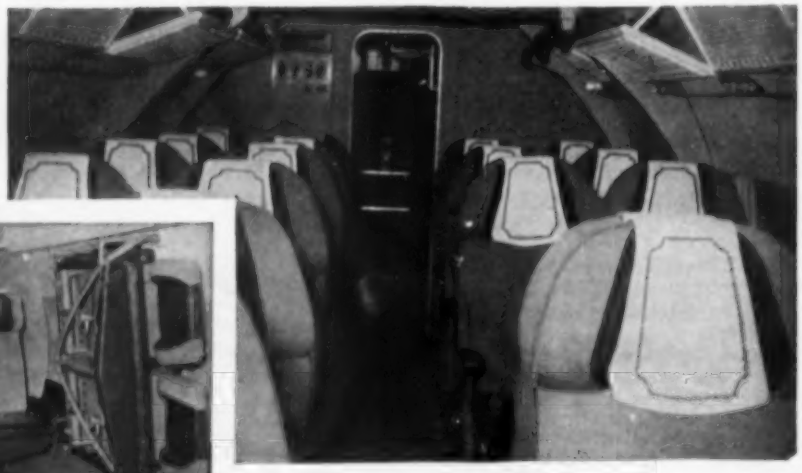

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First Aeronautical Weekly in the World

Founded 1909

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Full Ahead

THERE are men in the Navy today who must know how the Ancient Mariner felt when disencumbered of his pendulous albatross. They are those concerned, jointly with Armstrong Siddeley, Fairey and Westland, in the development and operation of the Double Mamba and Python turboprops, respectively powering the Gannet and Wyvern. Both these big "sea snakes" have met with problems of control, rendered the more intractable by peculiar demands of carrier operation; but each has nevertheless been brought to a stage where it can be operated without restriction in its designated role.

This knowledge is both reassuring—in that the Wyvern and Gannet are the standard carrier-borne strike aircraft and the standard submarine-killer in Fleet Air Arm service—and technically significant, for America has been less fortunate (and perhaps less active) in resolving similar difficulties. Though at one time the U.S. Navy had intended that the turboprop Douglas A2D Skyshark should succeed the piston-engined AD Skyraider as a single-seat strike aircraft (Wyvern equivalent), the difficulties of engine development were such that only a service-test batch of ten Skysharks was put in hand. True, the pure jet has since gained in favour with the U.S.N. for fixed-wing carrier-borne machines, other than those designed for anti-submarine duties; but this in no way detracts from Britain's achievement in clearing the turboprop for carrier service. Indeed, it is in the anti-submarine role—for which, as we have remarked, America retains the piston engine—that the airscrew-driving turbine is likely to find its most valuable naval application, and not in fixed-wing machines alone.

In the coming months the Gannets will be joined at sea by the Short Seamews, lighter, and with a single, instead of a Double, Mamba, though conforming to the Royal Navy's long-laid plan for standardization of the turboprop for specific duties.

These considerations add point to the report in this issue that H.M.S. *Eagle* has been working up with squadrons of Wyverns and Gannets—that she is, indeed, the first carrier yet to embark a Gannet squadron. The training mishap which has inevitably set back her programme in no way minimizes the significance of an event which was appropriately marked by the presence on board of leading personalities from the aircraft industry. Numbered among these was a director of A. V. Roe and Co., Ltd., who, according to a Canadian report, are engaged in the development of a supersonic delta-wing intercepter. So, just as the Navy has led the way in turboprop development, so new forms of aircraft, and possibly of propulsion also, may soon be advancing under the White Ensign.

Systematic Approach

AS guided-missile technology advances and conventional aircraft performance increases, the extreme importance of efficient functioning of what have come to be known as "systems"—powered controls, air conditioning, pressurization, fire control and guidance—makes itself felt to a growing extent. The success of any operational flight depends upon more factors than ever before, and the failure of any one of an aeroplane's systems can easily render abortive a vital and carefully planned sortie. It has also been brought home forcefully that, however good may be the individual components of, for example, a hydraulic or an air-conditioning system, its effectiveness can be seriously reduced if it is not suitably accommodated.

Equipment in military aircraft is taking more and more of the available space, and at the same time it is becoming increasingly sensitive to its location and operating conditions within the airframe. Failure to realize the optimum performance of equipment can often be traced to the fact that it was incorporated into the aircraft after the airframe design had been finalized.

The conclusion which must be drawn is that, at the earliest possible stage in design and prototype construction, the concept should be complete and every one of the requirements for its operational role fully provided for. It is no longer a practical approach to the problem for the airframe designer to work out his aircraft project in advance and, having satisfied himself as to the main details, only then to bring in the specialist designers and manufacturers concerned with weapons and other systems.

SOMETHING TO CELEBRATE: This cheerful stair-full was photographed at Wisley Airfield when, as described on page 742, the first of 60 Viscounts for Capital Airlines was handed over. Names are:— Camera side of steps, top to bottom: Mr. G. R. Edwards, Vickers-Armstrongs aircraft division managing director; Mrs. Murchison; Maj-Gen. C. A. L. Dunphie, V-A. chairman; Mrs. Carmichael; Sir Ronald Weeks, Vickers, Ltd., chairman. Far side of steps, top to bottom: Mr. C. R. Murchison, Capital Airlines' executive committee chairman; Mr. J. B. Franklin, vice-president operations and maintenance; Mrs. Franklin; Lady Weeks; Mr. J. H. Carmichael, Capital president; the American Ambassador, Mr. Winthrop Aldrich.

FROM ALL QUARTERS

Vickers Form U.S. "Viscount" Company

HARDLY a surprise, perhaps, in view of the impact which the Viscount has made on American ideas about airline equipment, but notable news nevertheless, is a Vickers-Armstrongs announcement of the formation of a United States subsidiary, Vickers-Armstrongs, Inc. The parent company hold the entire paid-up capital of $200,000 (£71,000). The initial function of the new concern, which is registered in Delaware, is "to provide technical after-sales service for Vickers' aircraft and to sell aircraft spare parts in the United States."

Its formation follows the sale of 60 Viscounts to Capital Airlines, and the decision, announced last year, to set up a spares store at Alexandria, Va., near Capital's Washington H.Q. This store will provide the airline with over-the-counter supply of all airframe and accessories parts, in effect closing much of the geographical gap between operator and manufacturer, and reducing the size and cost of Capital's own spares inventories.

The address of the technical office of the new company is Room 410, 1523 L Street, N.W., Washington, D.C. Mr. Allen Greenwood has been appointed executive vice-president, and Mr. Richard Botterill chief technical representative. Directors are Mr. T. Roy Jones, Mr. John I. Snyder, Mr. George R. Edwards, Mr. Ronald P. H. Yapp and Mr. Christopher Clarkson.

Mr. Jones is president of Daystrom, Inc., a management holding-company with seven operating units in the electronics, furniture, graphic arts, and guided-missile fields. The other American director, Mr. Snyder, is chairman of the board and president of the U.S. Industries, Inc. He is also a member of the boards of directors of two other U.S. corporations. Mr. George Edwards is, of course, well known as managing director, aircraft, of Vickers-Armstrongs, Ltd., and as leader of the Viscount design/sales team. Mr. Yapp is also a director of Vickers-Armstrongs, Ltd., and Mr. Clarkson, who was Britain's Civil Air Attaché in Washington 1948-52, represents Vickers-Armstrongs in the U.S.A.

K.L.M. Profit

THE 1954 annual report of K.L.M. announces that the airline's operations yielded a profit of just over £1m during the year. Of this sum £300,000 has been added to the general reserve and the remainder is being paid out as a 5 per cent dividend on ordinary shares. During the year K.L.M. increased their capacity by 21 per cent and their sales by 16 per cent.

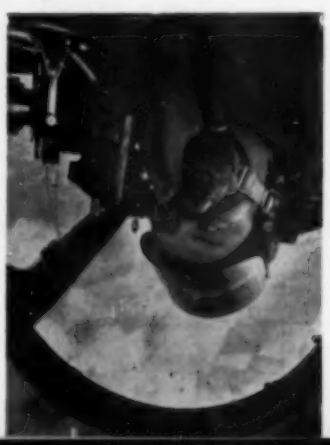
No mention is made in the report of the recent K.L.M. order for Douglas DC-7Cs; neither is there any reference to the Viscount, in which K.L.M. have lately been showing renewed interest. On this subject the report notes guardedly that "aircraft powered by turboprop engines are already being used for short-haul transport on a modest scale . . . there are indications that it will be some years yet before the turbine-engined transports can be put into general service." It is officially stated in the report for the first time that K.L.M. have placed an order for two Fokker F.27 Friendships, for delivery in 1958.

Several executives of K.L.M., including General Aler, the President, visited Weybridge last week to discuss, and fly in, the Viscount. A further visit was made early this week by the airline's deputy president, Mr. M. K. van der Ploeg, who said that no contract would be signed during his stay. He added, however, that if K.L.M. did decide to buy, they would require between seven and ten Viscount 800s; to order less would be uneconomical.

N.P.L. on View

TANDEM-ROTOR helicopter wind-tunnel research was demonstrated to visitors to the annual Open Day at the National Physical Laboratory, Teddington, on May 20th. This was just one of the large number of aerodynamic and scientific exhibits.

The helicopter model was on view in the Aerodynamics Section's 9ft × 7ft South Tunnel, and was seen to incorporate a fixed forward



COCK-A-HOOP: Exceptional in every way are the views on this and the opposite page of the aerobatic team of No. 43 Squadron (the Fighting Cocks), based at Leuchars. The aircraft are Hawker Hunter F.1s, and the pictures are the work of Mr. M. H. Chase, M.M., A.R.P.S., of the Air Ministry, seen (right) in a self-portrait, somewhat disfigured by g.

rotor and a movable rear rotor. Both rotors are geared together and driven by two coupled 3 h.p. electric motors housed within the helicopter fuselage. At maximum speed the rotors revolve at 1,800 r.p.m. and 400 ft/sec tip-speed, producing a centrifugal force of some 2,500 g. The lightweight blades are constructed of hollow magnesium, with brass leading-edges. The present test programme on this model includes basic lift, drag and pitching-moment measurements for various rotor configurations.

Several of the aerodynamic exhibits were concerned with the study of flow separation at supersonic speeds, over two-dimensional wing-sections and flat and curved plates. The use of suction through a porous skin for achieving laminar flow over a fuselage was demonstrated on a body of revolution mounted by means of a stub wing to the overhead balance of the 13ft×9ft tunnel. This investigation includes an examination of the use of suction for improving the flow at wing/root junctions.

Most of the N.P.L.'s other tunnels were also used to good advantage in displaying the varied aspects of the work performed there, from the supersonic flow around a swept-wing half-model in the 18in×14in tunnel of High-speed Laboratory "A," to the airflow over ships, being investigated in the open-jet tunnel.

Royal Message to Helicopter Association

A MESSAGE from the Duke of Edinburgh to the Helicopter Association of Great Britain was read by the retiring president, Mr. Eric Mensforth, at the Association's tenth annual general meeting, held on May 20th. The message said:—

"I send my best wishes to the Helicopter Association of Great Britain on the occasion of its Tenth Annual General Meeting.

"I have good cause to know the value of helicopters. I have also seen them in use by the Army and the Royal Navy and for rescue purposes by the Royal Air Force.

"The helicopter as it stands today is a very considerable achievement, but it is still at the beginning of its career. Anything you can do to speed its development will be a great benefit to Great Britain. Here is a field of engineering wide open for pioneers; the difficulties may be great, but the rewards will be much greater still.

"The Helicopter Association has the backing of everyone who is interested in this form of transport. I hope it will not be long before helicopters designed and built in Great Britain are in use in large numbers all over the world."

After saying that the Association was very honoured to receive this encouragement, Mr. Mensforth went on to review the activities of the past year.

The result of the ballot to fill the five vacancies on the Council was announced, the new members elected being Mr. A. McClements, Dr. J. A. J. Bennett, W/C. R. A. C. Brie, Dr. G. S. Hislop and Capt. J. A. Cameron.

Present at the meeting was Lord Douglas of Kirtleside, chairman of B.E.A., who was welcomed as president for 1955-56.

Aluminium's Centenary

OPENING on Wednesday next, June 1st, at the Royal Festival Hall, London, is the exhibition which, sponsored by the Aluminium Development Association and the light-metal industry, will mark the centenary of aluminium as a commercial metal, and tell the story of an industry that has been built on research. Aircraft components are to figure among the exhibits.

The exhibition remains open until the evening of Friday, June 10th, with the exception of the Sunday and also Friday, the 3rd, when the Duke of Edinburgh will visit the exhibition. Admission will be confined to the industry (on presentation of trade cards or cards obtainable from the A.D.A. at 33 Grosvenor Street, W.1), but on Saturday, June 4th the general public will be admitted in limited numbers and without charge.

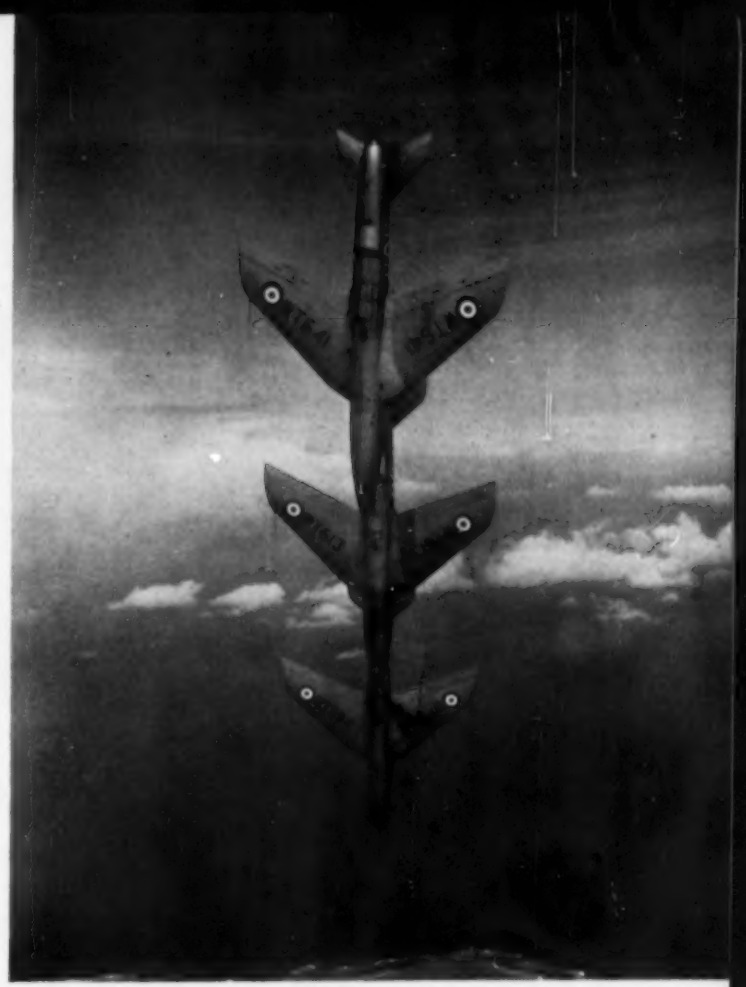
East African Accident

A FINE safety record was marred on May 18th, when East African Airways DC-3 VP-KKH crashed on Mount Kilimanjaro during a flight from Dar-es-Salaam to Nairobi. The aircraft, which was completing a scheduled service from Durban, was missing until May 22nd, when another of the airline's DC-3s sighted wreckage at about 14,500ft on Mawenzi, the lower of Kilimanjaro's two peaks. There was thought to be no hope of survival for any of the 20 occupants—16 passengers and four crew. The passengers included the wife of G/C. Malin Sorsbie, O.B.E., the general manager of East African Airways.

Glider Registration Concession

GLIDERS flown within the United Kingdom are now exempt from the M.T.C.A. requirements of registration and airworthiness certification, provided their owners have third-party insurance cover, the Air Navigation Order, 1954, is complied with, and (as the Ministry solemnly declares) the gliders "are not being used as aerial work or public transport aircraft". The announcement is made in M.T.C.A. *Civil Aviation Information Circular No. 47/1955.*

The British Gliding Association's rule that all gliders flown from the sites of member-clubs must possess a B.G.A. certificate of airworthiness remains unaffected, of course, and the main effect of the Ministry ruling is to extend the Association's responsibility to new gliders. Previously, new types and new production machines required an A.R.B. certificate of airworthiness: for all others, B.G.A. certification sufficed. The airworthiness of British gliders is now completely the responsibility of the B.G.A., through the Association's Technical Committee.



Westland Board Appointment

IT is announced that General Sir Kenneth Noel Crawford, K.C.B., M.C., has been elected to the Board of Westland Aircraft, Ltd. Sir Kenneth, who retired from the Army in 1953, is a former Deputy Chief of the Imperial General Staff; he was appointed to the post in 1947 after being G.O.C. British Troops in Greece. Previously, from 1942 until 1946, he was Director, Air, at the War Office, and was responsible for the organization of the Airborne Forces; he is himself a qualified parachutist. For four years prior to his retirement Sir Kenneth was at the M.o.S. as Controller of Supplies (Munitions).

U.S.A.F "At Home"

LAST Saturday was America's "Armed Forces Day", when a great many Service establishments, in Europe as well as in the United States, were open to the public. The U.S.A.F. opened a number of its bases in this country, and the following report, from a correspondent who visited Upper Heyford, indicates the scale at which arrangements were made for interesting the visitors.

Hospitality (he writes) was the keyword at Upper Heyford, when the 3918th Air Base Group, Strategic Air Command, was thrown open. The weather did not quite give the base commander, Col. Timothy J. Dacey, the full co-operation he deserved, but the several thousand people who visited this Oxfordshire station found plenty to compensate for the climate.

It is difficult to interest the public in aircraft, and in the vast organization behind them, without having an actual flying show; but—and especially in view of the wintry conditions that prevailed—on Saturday much more time could be devoted to the

"Flight" photographs (above and left)

R.Ae.S. AWARDS PRESENTATION

The 43rd Wilbur Wright Memorial Lecture of the Royal Aeronautical Society on May 19th was delivered by Dr. C. S. Draper (right) and before the lecture the Society's awards were presented. Mr. N. E. Rowe, the new president (top right) handed them to the recipients, who are seen in these photographs from right to left, as follows:

Lord Hives, chairman of Rolls-Royce, Ltd. (R.Ae.S. Gold Medal); Dr. R. A. Fraser, formerly of the N.P.L. (R.Ae.S. Silver Medal); Dr. A. A. Griffith, Rolls-Royce (R.Ae.S. Silver Medal); Prof. M. J. Lighthill, Manchester University (R.Ae.S. Bronze Medal); Mr. J. Taylor, R.A.E. (Wakefield Gold Medal); Mr. G. H. Dowty, chairman of the Dowty Group (British Gold Medal). *Lower row, right to left:* Dr. S. G. Hooker, Bristol engine division (British Silver Medal); Mr. R. C. Morgan, B.E.A. (George Taylor of Australia Gold Medal); Dr. D. Williams, R.A.E. (Simms Gold Medal).

FROM ALL QUARTERS . . .

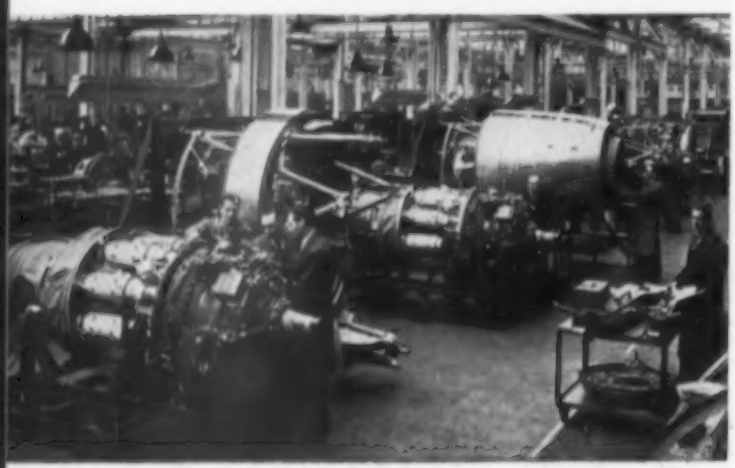
various exhibits that were open for inspection and, consequently, the absence of flying was not noticed.

The static display was divided into two sections—aircraft and equipment. The former consisted of a B-47E, B-45C, C-47, KC-97G, F-84G and F, F-86D and T-33A. Supplementing this all-American showing was an R.A.F. representation in the shape of a Canberra B.2, Hunter F.1, Chipmunk T.10, Provost T.1 and Vampire T.11. It was a pity that a Valiant from nearby Gaydon could not be shown opposite the B-47E; but this was America's day, and it was not for us to begrudge them a more impressive display of aircraft. The variety of markings carried by the U.S. aircraft was certainly bright, to say the least.

In the equipment section were shown examples of a 75 mm "Skysweeper" gun of the 4th A.A.A. Battalion stationed at Upper Heyford, a mobile weather station, fire-crash equipment, the 98th Chemical Smoke Generating Company, and a vehicle squadron, with M.T. ranging from the ubiquitous jeep to the B-36's tug.

When the visitor had seen all there was in this part of the station and had run out of questions to ask the multitude of personnel always ready to supply answers, tours of the whole base were available, *via* mess halls, barrack blocks and the P.X., while the more sportsminded toed the line to watch—and wonder at—exhibition matches of American baseball and softball.

The whole day was punctuated by a profusion of refreshments (all without charge!) which could only be described as staggering, and there can be no doubt that the hard work put in by 1st Lt. William S. McGrath as Assistant Project Officer and the personnel of 3918th A.B.G. did much to further goodwill between the people of Oxfordshire and the U.S.A.F. and in particular to assist in an understanding of the vast organization of S.A.C. itself.



R.Ae.S. Honours and Awards

SEEN in the series of photographs above is the presentation of the Royal Aeronautical Society's annual awards, made on the occasion of the Wilbur Wright Lecture. The lecture—on the history of flight control, by Dr. C. S. Draper, head of the Department of Aeronautical Engineering at Massachusetts Institute of Technology—was summarized on page 607 of our May 13th issue, when we also set out the list of award winners with a note on the kind of achievement for which each award is made.

At the Society's annual general meeting, a fortnight earlier, Honorary Fellowships were awarded to Mr. Igor Sikorsky and Mr. H. Grinsted (photographs of the presentation appeared on page 607, May 13th issue), and on that occasion the election of 22 new Fellows was also announced. It is now possible to give names:—

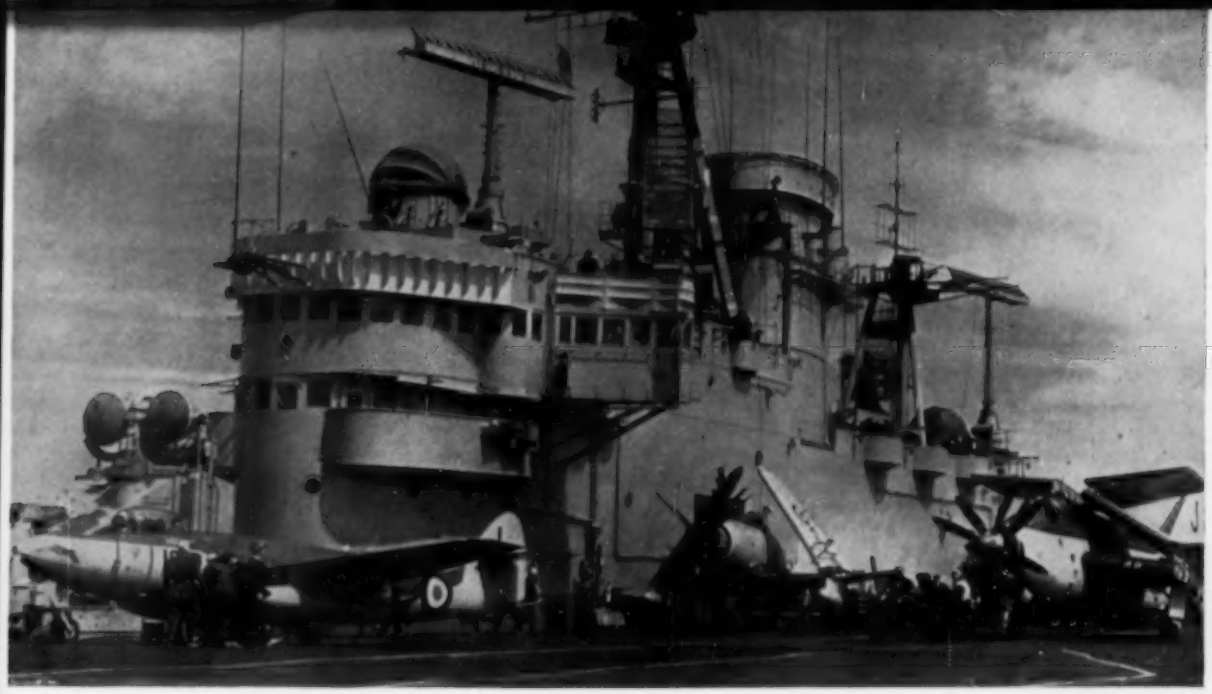
Dr. K. G. Bergin, medical superintendent, B.O.A.C.; G. B. Bolt, chief engineer, Tasman Empire Airways; Air Marshal Sir John N. Boothman, A.O.C-in-C., Coastal Command; Dr. N. A. de Bruyne, founder and managing director, Aero Research, Ltd.; H. W. Clarke, chairman and managing director, James Booth and Co., and president of the Aluminium Development Association; E. J. Earnshaw, technical director, Plessey Co., Ltd.; W. M. Evans, Chief Engineer, Air Registration Board; J. C. Floyd, vice-president (engineering), Avro Aircraft, Ltd., Canada; Sir Wilmot Hudson Fysh, chairman and managing director, Qantas Empire Airways; E. A. Gibson, director of Civil Aviation, New Zealand; Dr. J. Hadji-Argyris, reader in the theory of aeronautical structures, University of London; Dr. G. S. Hislop, chief designer (helicopters), Fairey Aviation Co.; D. James, chief stressman, Vickers-Armstrongs, Ltd., and chairman of R.Ae.S. Structures Committee since 1951; J. C. Kelly-Rogers, deputy general manager (technical), Aer Lingus; P. McCormack, Chief Aeronautical Engineer, Irish Air Corps, and chief engineer, Aer Lingus; Sir Arthur de Terrotte Nevill, Deputy Director of Civil Aviation, New Zealand; Dr. J. H. Preston, Lecturer in Aeronautics, Cambridge University; T. Simpson, chairman and managing director, H. M. Hobson, Ltd.; Sir Lawrence J. Wackett, manager and technical director, Commonwealth Aircraft Corporation; J. L. Watkins, technical adviser to British Commonwealth Pacific Airlines; F. L. Wattendorf, Director, A.G.A.R.D. Secretariat; D. H. Williams, principal scientific officer, Aerodynamics Division, N.P.L.

Helicopter Training

A TRAINING school for helicopter pilots and maintenance engineers is to be started by Fison-Airwork, Ltd., the new firm of helicopter operators being formed jointly by Airwork, Ltd., and Fisons Pest Control. The Hiller 360s which the latter firm employ on agricultural work will be used for pilot training.

It is the intention to provide full basic training for pilots up to the point when only some ten hours conversion flying would be necessary for them to qualify on current British-made helicopters. Ground maintenance courses will also be provided, the company's base for helicopter operations continuing to be at Bourn, Cambridge, for the time being.

UNIQUE, in that they are the only turboprops in the 4,000-h.p. class anywhere in the world cleared for unrestricted passenger operation, Bristol Proteus 705s are in full production for the 15 Britannias for B.O.A.C. The 705, giving 3,780 e.h.p., will later be succeeded by the more powerful Proteus 755.



"Flight" photographs

Against "Eagle's" superstructure, a Sea Hawk of No. 804 Sqn., a Wyvern of No. 827, and a Gannet of No. 826 appear almost insignificant.

BROOD OF THE EAGLE

Gannets, Wyverns, Sea Hawks, Skyraiders, Dragonflies

(Above) The Fifth Sea Lord, Rear Admiral A. N. C. Bingley, O.B.E. (right) and Capt. E. D. G. Lewin, C.B., D.S.O., D.S.C., R.N., commanding H.M.S. "Eagle." (Below, l. to r.): W. F. Saxton (Armstrong Siddeley), J. A. R. Kay (Avro), and D. L. Hollis Williams and W. H. Sear (Westland) enjoy a "goofing" session on the morning of May 16th.

ONE eagerly accepted the invitation of Capt. E. D. G. Lewin, C.B., D.S.O., D.S.C., R.N. to sail with him for a short time aboard H.M.S. *Eagle*, before her first General Service Commission. Already embarked when we joined the great carrier at Spithead were most of the allotted aircraft—Hawker Sea Hawks of Nos. 802 and 804 Sqns., Westland Wyverns of No. 827, Fairey Gannets of No. 826, a flight of Douglas Skyraiders of No. 849, and two Westland-Sikorsky Dragonflies which form *Eagle's* Helicopter Flight. Only No. 813 Sqn. (Wyverns) had still to join.

Commanding the various squadrons were: 802, Lt-Cdr. I. H. F. Martin, D.S.C., R.N.; 804, Lt-Cdr. R. O. Price, D.F.C., R.N.; 813, Lt-Cdr. R. M. Crosley, D.S.C., R.N.; 826, Lt-Cdr. E. F. Birch, R.N.; 827, Lt-Cdr. S. J. A. Richardson, R.N. The Skyraiders of No. 849 ("A" Flight) were under the command of Lt-Cdr. G. E. Legg.

As fellow guests we had the Mayor and Sheriff of Exeter (which city has adopted *Eagle*, in the present absence of a naval vessel bearing the city's name); and "industrialists" who had accepted Capt. Lewin's invitation included Mr. Hollis Williams, Capt. Traill, and "Slim" Sear (Westland Aircraft); Messrs. Saxton and Lindsey and Rear Admiral Ross (Armstrong Siddeley); Mr. Kay (Avro); Messrs. Hough and Wilson (Armstrong Whitworth); Messrs. Sturgeon and Metcalfe (Ultra Electric); F/L. Harker (Rolls-Royce); and Dr. Roberts and Mr. Evans (Fairey).

The ship had been exercising for some days in the Channel before sailing for the Mediterranean on May 21st, though her departure was eventually delayed until the damage sustained when a Wyvern collided with the superstructure (as already widely reported) had been repaired.

When we ourselves were aboard, the flying programme was going ahead satisfactorily; which is not to say that a pained expression did not sometimes cloud the features of Cdr. I. F. Pearson, a member of the Carrier Working-Up Flight. Of Gannet flying we saw comparatively little, but on all sides there was praise for the machine; and certainly there was no doubt as to its docility. A Gannet on the approach is one of the most reassuring sights imaginable, and the landing, apparently, leaves nothing to be desired.

The Wyvern, too, after many vicissitudes, is now very much a going concern, fully cleared for catapulting, thoroughly well liked by its pilots and, withal, still representing a very notable technical achievement. At low and medium levels it has a Vampireish performance and is, we are assured, an unusually steady flying machine. We had as cabin-mates Lts. Iveson and Teague, of

(*Continued on page 745*)

HERE AND THERE

ONE OF SEVERAL Hunting Percival T-53 Provosts for the Royal Iraqi Air Force. The first batch of four left Bovingdon on May 18th on the first leg of their delivery flight, led by G/C. P. Heal, A.F.C., air adviser to the Royal Iraqi Air Force. The other machines were piloted by Lt-Col. Wadood Faraq, Lt-Col. Mahmoud Shakir, and Lt-Col. Kaleel Shafik.

Royal Heron Delivered

THE specially prepared Series 2 Heron for the Queen's Flight was taken over by the Duke of Edinburgh and S/L. Gordon at Hatfield on Thursday last week. On the previous day the aircraft had made a short flight during which the Duke took the controls. Notes on the equipment of the machine, and interior and exterior photographs, appeared in *Flight* of April 1st.

For the Nation

ON loan to the Science Museum since 1926, the 1910 Antoinette monoplane has been presented for permanent inclusion in the Museum's National Aeronautical Collection by its owner, Mr. Robert Blackburn, chairman of Blackburn and General Aircraft, Ltd. The machine, of particularly graceful and striking design, was brought to this country by Hubert Latham in 1910.

Fun o' the Fair

WHITSUNTIDE air events round-up: Whit-Monday: National Air Races and S.S.A.F.A. Display at Yeadon, near Leeds —see page 743; Royal Netherlands International Air Display at Ypenburg; Women's Junior Air Corps Flying Display (with Service participation) and Rally, White Waltham, near Maidenhead—2 p.m., admission 2s, children 1s, cars with occupants 10s; Aero Club of Ireland's Display at Weston Aerodrome, Leixlip, near Dublin. Whit-Sunday (11 a.m.-6 p.m.) and Whit-Monday (10-5): Society of Model Aeronautical Engineers' British National Championships, R.A.F. Station Waterbeach, near Cambridge—admission by programme, price 6d, car parking 2s 6d.

Handicappers Wanted?

1955 AWARD in the Dorothy Spicer Memorial essay competition organized by the Society of Licensed Aircraft Engineers goes to Mr. R. A. Fry, A.R.B. surveyor—for the third time. He gained the prize for a paper on "Inspection Aspects of Aircraft Fatigue." The S.L.A.E. Gold Badge for 1954 has been awarded to Mr. J. Leeson of the B.E.A. Helicopter Unit for a paper which, says the Society, has proved of exceptional value in introducing helicopter engineering to maintenance engineers previously unfamiliar with such aircraft. The awards were announced at the Society's 12th A.G.M., held in London last Saturday, when Sir Frederick Tymms gave an address on *International and National Regulation of Airworthiness.*

World Air Forces Data

THE demand for the special Military Aviation (World's Air Forces and their Aircraft) Number of *Flight*, published on May 13th, was even heavier than expected, especially from air forces and government departments abroad. Arrangements had, however, been made to hold a limited number of copies in reserve to meet further applications from such sources, and these may be obtained at normal price; orders should bear indication of their official origin.

Operation Handclasp

TAKING part in the goodwill mission of the above name, four U.S.A.F. Republic Thunderjets have flown non-stop from Tokyo to Australia, as forecast in *Flight* of May 13th. They landed, on May 21st, after being over 12 hours airborne, at the R.A.A.F. base at Williamtown, N.S.W., having refuelled in flight over Guam, over Momote, in the Australian territory of New Guinea, and over Townsville, North Queensland. Mr. Athol Townley, the Australian Minister for Air, has described the flight as a "dramatic demonstration of aerial efficiency . . . of deep significance for Australia." Doctors found that the Thunderjet pilots were in excellent physical and mental condition and not unduly fatigued.

Russia and the Canadian Fair

THE Soviet Ambassador to Canada, Mr. Dimitri Chuvakhin, has announced that the Soviet Union will exhibit "its latest aircraft" at the Canadian International Air Show next year. He added that Russia would have taken part in this year's show (which is being held in connection with the International Trade Fair at Toronto from May 30th to June 1st) but invitations arrived too late for preparations to be made.

Filton to Malton

ANOTHER exhibit for the Toronto Fair will be a Bristol Sycamore, which last Tuesday began its export journey from Filton under its own power—it was flown to Avonmouth Docks, where it landed alongside the ship *Gloucester City*; its rotor was then removed and it was lifted on board by a 10-ton crane. The aircraft will give demonstrations at Malton Airport during the Show.

500th CROSSING of the North Atlantic is the reason for the modest smile on the face of Capt. S. W. A. Scott, a B.O.A.C. senior captain, 1st class. He is the first British pilot to reach the 500

FAMILY GROUP: Assembled at Turin are (right) six types of Fiat trainer—in the foreground the newly tested G-92 (Nene), the G.80-3B (Goblin) and G.80-1B (Goblin), G.59 (Merlin), G.49-2 (Wasp), and—most distant—the G.46 (Alfa 115-1ter).

power in four packages
One big advantage of the Napier Eland propeller-turbine is easy maintenance. Eland power comes in four packages — (1) the reduction gear assembly, (2) the compressor assembly, (3) the main support plate and combustion chamber assembly and (4) the turbine unit. Interchangeability of these major components is catered for, thereby ensuring simple and cheap maintenance.
more facts about the Eland
* High aerodynamic efficiency — 3,000 e.h.p. in a maximum diameter of 36 inches.
* Low specific weight — 0.52 lbs./e.h.p.
* Low specific fuel consumption — 0.450 lbs./e.h.p./hr. at 36,000 ft. 400 knots cruising: 0.505 lbs./e.h.p./hr. at 20,000 ft. 350 knots cruising.
* Ease of control — single lever control with manual over-ride, guards against engine overspeeding and overfuelling.
* Automatic temperature compensation.
* At the first attempt the Eland has recently passed a 150 hour type test rehearsal at the full 3,000 e.h.p. rating.
NAPIER Eland turbo-prop
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D

CONGRATULATIONS TO GLOSTER ON
THEIR FORTIETH BIRTHDAY

The illustration shows 'Javelins', standard all-weather fighters for the R.A.F., fitted with vital Lockheed hydraulic equipment

ALL-BRITISH
Lockheed

FOREMOST IN HIGH-PRECISION HYDRAULICS

AUTOMOTIVE PRODUCTS COMPANY LTD., LEAMINGTON SPA, ENGLAND

MARS TO JAVELIN

GLOSTER AIRCRAFT OF FORTY YEARS By H. F. KING, M.B.E.

With a special contribution by A. Cdre. A. H. Wheeler, C.B.E.

PART I: WAR AND PEACE

TO a remarkable degree the story of Gloster technical development is a record of British fighter design, though it embraces also machines of other classes, notably a brilliant family of racers. We outline the story here to the point where delta-wing Javelins are soon to be issued to R.A.F. squadrons—among them, perhaps, units which years ago were rejoicing in their Grebes, Gauntlets or Gladiators.

The beginnings were to be seen in 1915, when the wood-workers of H. H. Martyn and Company, of Cheltenham, Glos, widely known as architectural engineers, and especially for their wood-panelling in ocean liners, were turning out Maurice Farman spares and propellers for Short seaplanes; from which occupation they industriously proceeded to fuselages for D.H.4s and 6s. A turning point is marked by *Flight* of June 14th, 1917, wherein appears the name of the Gloucestershire Aircraft Co., Ltd., newly registered, with a capital of £10,000, as acquiring the business carried out by A. W. Martyn. Directors were G. Holt Thomas (chairman), G. A. Peck, A. W. Martyn (managing director), T. O. Williams, D. Longden and H. Burroughes. As the genial Mr. Hugh Burroughes the last-named continues today as an active member of the Gloster board and—an even higher tribute to his powers—as managing director of the vast Hawker Siddeley Group, of which Gloster Aircraft is a member-company.

As the war drew to its end the Cheltenham works turned over largely to Bristol Fighters, of which some 80 a month were being turned out from the Sunningend works when the armistice at length arrived. And with it came the slump. The directors, nevertheless, resolved to engage a professional designer with the necessary technical staff to plan a series of machines which would place the company's name in the forefront of technical advance. To this end they engaged, first as a consultant and later as a full-time member of the staff, Mr. H. P. Folland, who had been largely responsible at Farnborough for such remarkable aircraft as the S.E.4, S.E.5 and F.E.2B. Later, as chief engineer and designer to the British Nieuport Co., Ltd., he had designed the B.N.1 and Nighthawk fighters and the London triplane bomber.

To Mr. Folland the success of Gloster fighters in the period 1921-37 must be largely ascribed. From the basic Nighthawk, which the company was already producing in quantity for the British Government, he evolved first the Mars I, or Bamel—a truly Lion-hearted racer—and a series of fighters, variously fitted with the Bentley B.R.2 rotary or the Bristol Jupiter and Armstrong Siddeley Jaguar static radial engines. These machines were supplied in fair quantities to the Japanese, Greek and British Governments. Additionally, there were contracts for the construction of D.H.9a wings and for the overhaul and reconditioning of 9a and Parnall Panther airframes.

At 163.3 m.p.h. "Jimmie" James brought the Mars I home victorious in the Aerial Derby of 1921, a success it was to repeat in 1922 (176 m.p.h.) and again in 1923 (192.4 m.p.h.). In the course of its career, with James, or "Larry" Carter, as pilot, this "half-pint" biplane secured unofficial records for speed and rate of climb, and was finally acquired by the Air Ministry. It was the progenitor of Gloster's beautiful Schneider racers of later years.

Always an advocate of the biplane, Mr. Folland began to investigate special wing sections and layouts, seeking to reconcile performance and useful load to a higher degree than hitherto. The combination adopted consisted of a high-lift top wing with a medium-lift bottom wing, which, although providing lift for take-off, contributed very little at high speeds. Consequently its drag was low. Something approaching monoplane efficiency was achieved, though with a much reduced span.

The first machine to incorporate the new arrangement was the Grouse, a rotary-engined two-seater which was developed, with Jaguar engine, into the single-seat Grebe, adopted as a standard R.A.F. fighter in 1923. In that year, too, the Gannet (gross weight 460 lb, wing span 18ft) was built for the *Daily Mail* Light 'Plane Trials at Lympne.

The Gloster II, a Lion-engined racing seaplane constructed for the 1924 Schneider race, was lost in an accident while being flown at Felixstowe by Capt. Hubert Broad. Italy had withdrawn her entries and America was left alone in the contest; but, rather than claim a fly-over, she consented to call the race off until 1925. In that year the race was at Baltimore. Broad, in a Gloster III, was the sole British participant, and he came in second.

Successor to the Grebe in production for the R.A.F. was the Jupiter-engined Gamecock, one of the most popular aerobatic machines ever to see service and one which was famed for its successes in the Sassoon Cup races.

A closely related type was the Gorcock, first of the Gloster fighters to have a water-cooled engine—the Napier Lion. Three were built, one of which was Gloster's first all-metal aircraft, and there were two examples of a similar machine known as the Guan, with experimental turbo-supercharged Lions.

During 1926 the company was beginning to occupy new works at Brockworth Aerodrome (a move which culminated in complete transference in 1929), and in November 1926 it changed its name to the Gloster Aircraft Co., Ltd. That year was significant in other ways, for it saw the company busy with the development of all-metal construction and with the building of a new type of racing seaplane—the Gloster IV—for the 1927 Schneider Trophy race.

Flown over the Lido, near Venice, the 1927 Schneider race was an Anglo-Italian contest, and Britain had no fewer than six racing seaplanes on hand—three Supermarine S.5s, the Gloster IVA and IVB, and the Short Crusader. In the blue-and-bronze IVB, F/L. Kinkead put up the remarkable lap speed of 289 m.p.h., but after five laps was forced to retire—and only in the nick of time, as we subsequently relate.

On the military side, the company was successful in securing business from Japan with its Gambet fleet fighter, though in this country the all-metal Goldfinch was ousted by Bristol's Bulldog.

Gloster's first bombers were the Goral (built for the general-purpose competition which was won by the Wapiti) and the private-venture Goring. Neither was built in quantity and attention was never far distracted from single-seat fighters: by 1929 two wholly new designs, the Gnatsnapper fleet fighter and the S.S.18 intercepter, had been realized.

For the 1929 Schneider race the company produced its first monoplane—for surprising reasons, as will later be explained. This was the Gloster VI, one of the most beautiful aeroplanes ever built and which achieved a record of 336.31 m.p.h.

More than most firms, Glosters appreciated the value of research, and in 1929 we find them experimenting with a Breda monoplane having a special variable-camber wing. This was flown first by Capt. R. H. Stocken and later by Capt. Howard Saint, chief test pilot from 1926 until 1933.

Another private venture was a helicopter, described by Mr. A. K. Laverton, now Gloster's works engineer, as looking like a tin shed with horizontal paddle wheels on top. Although this contraption managed to "heave itself into the air" it was obviously under-powered, and with a new engine it "rose . . . rather unsteadily, finally rolling over on one side, when one of the rotors caught in an overhead roof girder, and the machine was left suspended from a tangle of rotor and shafting."

To the designs of Mr. H. J. Stieger, Glosters built, in 1929, the Monospar twin-engined cabin monoplane, and a few months later constructed a wing on the Monospar principle for the Air Ministry's Fokker F.VII/3m. A year or two later, de Havillands, who had decided to concentrate solely on civil aircraft, handed

Pilot and designer "Larry" Carter and H. P. Folland.

MARS TO JAVELIN . . .

over to Glosters the partly completed D.H.72 three-engined night bomber and the D.H.77 intercepter, with Napier Rapier engine.

Under Gloster auspices, two companies—the Steel Wing Company and the Hele-Shaw-Beacham Variable Pitch Propeller Company—had established themselves at Brockworth. The first-named had, since 1919, acquired extensive experience in its own field before being taken over by Glosters in 1927.

With metal-working experience behind them, Glosters, for the first time in their history, were instructed to build aircraft to another company's design, namely the Armstrong Whitworth Siskin IIIA, of which 90 were turned out during 1927-29. The company also undertook Siskin modification and repairs. In the period 1929-32, 525 sets of Wapiti wings were built at Brockworth.

Hele-Shaw-Beacham airscrews were tested on Gloster's "hack" Grebe, with results later recorded, and four were made for each of three other types, the Bulldog, Fox and Siskin. A special machine was evolved for producing Duralumin blades, and these were applied to Schneider seaplanes and to Gorcocks.

Early interest was shown in projects for civil aircraft, and research in this field never really lapsed, for in 1925 a mock-up had been built of a machine called the Goodwood, the rear fuselage of which was hinged to facilitate loading. A spasm of official economy caused this project to be abandoned. Late in 1929, however, the company was again engaged on a civil design—for a twin-engined air-survey aircraft known as the A.S.31. This was a remarkable machine and did an equally remarkable job. Though in its day it was the largest machine bearing the Gloster name, it was quite overshadowed by the C.16/28 troop carrier.

Production of fish fryers, milk churns, one-off car-bodies, and Festing motorized barrows (designed to carry two 500 lb bombs) helped to keep the wolf from the door in the bleak early 'thirties; but although the Gnatsnapper fell by the wayside, the S.S.18 was progressively remodelled, re-armed and re-engined until it finally emerged as the Gauntlet. Though a carrier-borne T.S.R. remained "one-off," the Gauntlet was established by the mid 'thirties as the world's finest day and night fighter, and was in full production for the R.A.F. and many other Services.

In 1934 the company was amalgamated with Hawker Aircraft, Ltd., and during the period 1935-36 produced the Hawker Hardy, Audax and Hartebeest, to a total of 141 machines.

From the Gauntlet was evolved an even more famous fighter, to become known in the R.A.F., and in many other air forces, as the Gladiator, and in the Fleet Air Arm as the Sea Gladiator. By early 1940, 527 machines of the type had been built. Gladiator squadrons formed part of the Advanced Striking Force in France, and a Gladiator of 603 Squadron scored one of the R.A.F.'s first victories of the war when it shot down an He 111 over the Firth of Forth. In the Middle East, Gladiators were pitted against both the Luftwaffe and the Regia Aeronautica, and in Malta the deathless *Faith*, *Hope* and *Charity* flew in defiance of the enemy's onslaught. From Norway's frozen Lake Lesja, Gladiators were operated with the same heroism.

On the retirement of Mr. Folland, in January 1937, Mr. W. G. Carter had been appointed chief designer and engineer, having previously served with Glosters in connection with the de Havilland types, the transference of which has already been mentioned. It was Mr. Carter who ultimately converted Glosters to the monoplane fighter, exemplified by the F.5/34 eight-gun fighter and by two F.9/37 twin-engined fighters, all three later described. On the production side, Hawkers had handed over the Henley two-seater, of which 200 were completed.

By 1940 the labour force totalled some 11,000 workers, and that the Henley contract had been cut back from 400 machines was no great calamity, for by late 1938 an order for Hurricanes had been substituted. The company were occupied also on the building and operation of a Government shadow factory and in the laying down of runways at Brockworth. This was a time of great activity—and of great exasperation. Thus, in 1939, jigging and tooling were put in hand for Wellington bombers; but, when about nine months' work had been completed, the firm was instructed to deliver all jigs, tools, components and material to Vickers or their sub-contractors. They themselves were told to prepare to build Albemarles! But again, after much planning and tooling, the work was diverted, this time to the A. W. Hawksley Co., Ltd.

Gloster's first production Hurricane came out on October 27th, 1939. Exactly twelve months later 1,000 had been completed. The grand total in 1940 was 1,211 airframes, and in 1941, 1,359. In response to Lord Beaverbrook's appeal for still greater production, the company ultimately managed to complete a Hurricane every four hours round the clock, in addition to supplying 20-25 sets of Hurricane wings each week to Hawkers. They themselves admit that when, in 1938, they had been asked to increase Gladiator production to seven a week, the number seemed "incredible." Certainly no one at Brockworth dreamed that within two years 160 Hurricanes would be built in thirty days, though each machine required 50 per cent more man-hours than the Gladiator.

When other factories began to suffer from bombing the M.A.P. instructed Glosters to disperse, and a total of 43 factories (including garages, workshops and departmental stores) were eventually engaged, over a radius of about 30 miles. Nor were activities limited to production, for repair work was always pressing. "On occasions," runs a Gloster account, "aircraft that had been delivered to an operational unit on a Monday or a Tuesday were back in the Gloster repair shops by the following week-end."

The final figure for Hurricane production (Mks 1, 2, 2B and 2C) was 2,750, the last machine being delivered on March 21st, 1942.

To allow Hawkers to proceed uninterrupted with their own Hurricane production, Glosters received an M.A.P. contract for the Typhoon, the first being completed in June 1941. Early troubles with the Sabre engine rendered test flying exceedingly hazardous, and many are the stories told of breathless glides and dead-stick landings by the late P. E. G. ("Jerry") Sayer, Gloster's chief test pilot, and his gallant band, among them Michael Daunt, John Warren, Max Williams and John Grierson. From June until the end of 1941 only 28 Typhoon IAs were turned out, but in the following year 677 were completed.

On the technical side things were even more exciting, for since 1939 Mr. Carter and his team had been secretly at work on Britain's first turbojet aircraft. In that year Mr. Carter was working on the design of a twin-boom Sabre-powered fighter, with pusher propeller, and Frank Whittle considered this to be a suitable layout to receive the pioneer turbojet bearing his name. On the very eve of the war, then—in August 1939—Glosters embarked on perhaps their greatest venture of all, the E.28/39. As it finally emerged, this bore no resemblance to the twin-boom project. Two prototypes were built in the experimental shop at Brockworth, but, for safety, one was moved to Regent Motors' garage, in Cheltenham. There, under the eye of Mr. Jack Johnstone, who had supervised the building of every Gloster prototype since the Gamecock, work proceeded in great secrecy until April 1941.

After taxying trials the E.28 was transported to Crabtree's Garage, Cheltenham, for modifications to the undercarriage; and there, by torchlight, with A.A. shell splinters raining on the roof and electric power cut off, Mr. H. M. Yardley, the R.T.O., passed the undercarriage as airworthy. The following morning the aircraft was on its way to Cranwell for its momentous first flight on May 15th, 1941. The first fifteen flights, totalling ten hours, were completed in less than a fortnight, and in the eighteen months thereafter there was much flying from Edgehill, near Banbury. After "Jerry" Sayer's death in a Typhoon during October 1942, Michael Daunt took over the great work of development flying.

The development of the E.28, and of the twin-jet F.9/40 (Meteor prototype) aircraft, is described in some detail in later pages. It must be recorded here, however, that the first true flight of the F.9/40 was on March 5th, 1943, at Cranwell. The pilot was Michael Daunt. After about a month the M.A.P. issued instructions that this machine was to be transferred to Newmarket Heath, but the surface there was so undulating that Glosters immediately sought an alternative site, until Moreton Valence, an R.A.F. airfield a few miles from Brockworth, could be made ready. They selected Barford St. John, near Banbury, where the E.28/39 was to come at a later date. From Moreton Valence all Meteor development was subsequently carried on, and today it echoes to the thunder of Sapphire turbojets which power the production Javelins on their increasingly frequent flights.

Meteor highlights were John Grierson's delivery of the first production machine to the U.S.A. during 1943; deliveries to No. 616 Squadron, commanded by S/L. Andrew McDowell; patrol and escort work over the Normandy beachheads on D-Day, flying from Culmhead; successful employment against the V.1 flying bombs (especially F/O. T. D. Dean's first kill by upsetting a V.1 with his own wing-tip); and exercises with U.S.A.F. bomber formations and their Mustang and Thunderbolt escorts, with a view to determining the best defence against Me 262s.

The war over, and more powerful turbojets being available, Glosters lost no time in preparing for an assault on the world's speed record, and on November 7th, 1945, a Meteor 4, piloted by G/C. H. J. Wilson, put up the first jet record of 606 m.p.h. On September 7th of the following year, G/C. E. M. Donaldson, in a similar machine, raised this figure to 616 m.p.h., and S/L. W. A. Waterton (eventually to become the company's chief test pilot) attained 614 m.p.h. Significant, too, were tours by the company's own demonstrators, under Eric Greenwood's supervision, and such notable achievements as "Digger" Cotes-Preedy's Brussels-Copenhagen flight at 630 m.p.h.

Development of a two-seater night fighter was passed to Sir W. G. Armstrong Whitworth Aircraft, Ltd., and since the first Meteor N.F.11 flew, in May 1950, some hundreds of these machines have been delivered to several air forces.

A single-Nene Gloster fighter, the E.1/44, was not ordered in quantity, and the generally similar CXP-1001 Chinese Experimental Pursuit was never completed. Better fortune, however, attended the G.A.5, a massive night and all-weather fighter of extremely high performance, long range, and with the most for-

midable armament and detection installations; it was designed, under the technical direction of Mr. Carter, by Mr. Richard Walker. The first prototype of this mighty machine was flown by S/L. "Bill" Waterton on November 26th, 1951. In recording this event, we printed also the following statement by Mr. Percy Crabbe, Gloster's general manager: "While Meteor production has been going on, we have been steadily at work in our design and experimental departments on new aircraft just as versatile as the Meteor but adapted for the maximum use not only of current jet power but foreseeable power into the future. The G.A.5 delta is our answer to this vital design-problem. The low aspect-ratio of the delta wing provides minimum change in stability and control characteristics at sonic speeds. The delta plan-form permits engines, undercarriages, fuel and equipment to be contained inside one smooth envelope and the shape permits a very rigid and economical construction."

Since that time the Javelin has had its share of troubles and has cost the lives of two test pilots. But it has finally emerged, largely thanks to W/C. R. F. Martin, the company's present chief test pilot, as a fighting aircraft of exceptional merit, and one which will endow the Service with defensive powers of a matchless order. Already a new all-weather fighter is being developed from it.

But even now the Javelin is about five times as fast as the Sparrowhawks of the early '20s. That is the way of Gloster progress.

PART II: THE FAMILY TREE

RACING LANDPLANES

Bamel (alias Mars I or Gloster I) One of the most remarkable aircraft to appear in the year 1921 was the racing biplane built by the Gloucestershire Aircraft Company and known as the Mars I, though it was to achieve fame with the nickname Bamel. Entered for the 1921 Aerial Derby, and flown by J. H. James, it came home victorious at a speed of 163.3 m.p.h. The issue of *Flight* in which the race was described contained also the first detailed description, and remarked that the speed of production (the machine was built in less than a month) was partly accounted for by the fact that the rear fuselage and tail were those of a Nighthawk. The wing cellule was similar to that of the 1920 Nieuport Goshawk racer, being a single-bay structure, braced by single interplane struts, and was curious in that, although the top wing had elliptical tips, the lower wing was square-cut. The Napier Lion engine had a retractable radiator.

Particulars given in the original *Flight* description were: length 23ft, span 22ft, wing area 205 sq ft, gross weight 2,500 lb.

For the Coupe Deutsch contest held at Villesauvage, France, in September 1921, the wing area of the Mars I was reduced by 20 sq ft and the machine was fitted in France with two Lamblin "lobster-pot" radiators. Speed thereupon rose by several miles an hour, and, but for a failure in the stitching of the fabric, the Bamel would have acquitted itself with distinction. Later in the year another 20 sq ft of wing area was removed, together with one of the two Lamblin radiators; various minor items were cleaned up, the top bank of cylinders was completely faired in, and fairings were added behind the wheels. Formerly silver-doped, the machine was now finished in a glossy blue-and-white Titanine scheme, for which it will always be remembered by those who saw it. In this trim, on December 19th, 1921, it was put over the speed course at Martlesham Heath at an average speed of 196.4 m.p.h.—a "British record."

On August 7th, 1922, Mars I won the Seventh Aerial Derby at 177.85 m.p.h.; and again "Jimmy" James was the pilot. By this time the two Lamblin radiators had been restored and the wheel fairings removed. In the same year the machine was again entered for the Coupe Deutsch race, with wings further reduced in area; and once again it met with misfortune in that James experienced map-trouble and lost his way. Bent on putting up a new world record after the race, he made four runs over the official kilometre course at 212 m.p.h., though as this speed fell short of the statutory 4 k.p.h. increase, it was never homologated.

With wings of increased area, and flown by a Martlesham pilot, F/L. Rollo A. de Haga Haig, Mars I was officially timed for rate of climb on November 23rd, 1922. A height of 10,000ft was reached in 4 min 15 sec, and 19,500ft in 11 min 34 sec.

For the Aerial Derby of 1923 the same machine was reconstructed and renamed the Gloster I. The wings were those which had been fitted to the Bamel when it went to France in 1922, but they had been rebuilt with different ribs, to give a new contour. The old fuselage was retained, but the petrol tank, which had formerly been mounted on top of the fuselage had been moved inside. Tail surfaces, too, had been remodelled, and a single Lamblin radiator was fitted. In this form, and flown by Larry Carter, the machine won the Aerial Derby at 192.4 m.p.h. Final figures for the Gloster I landplane were: span 20 ft, wing area 165 sq ft, gross weight 2,650 lb. "She was a nice little thing," said W/C. A. H. Orlebar, after he had managed to steal a flight at Martlesham in 1923, "but a bit fierce."

Mars I.

Gloster I.

RACING SEAPLANES

Gloster I Seaplane The Air Ministry had promised to buy the winner of the 1923 Derby; and so it was that the Mars I/Bamel/Gloster I eventually found its way into uniform, was given the Service number J7234, and eventually mounted on floats, in which form it served as a trainer for the 1925 Schneider Trophy pilots. Various modifications were introduced during the course of its career as a seaplane, notably the fitting of surface radiators on upper and lower wings. Span was 21ft, speed 185 m.p.h.

Gloster II Two examples of this seaplane development of the Gloster I were built in 1924, with a view to participation in the Schneider Trophy contest, to be held at Baltimore in October of that year. While undergoing tests at Felixstowe, one of these machines, flown by Capt. Hubert Broad, sank after its undercarriage collapsed. The second eventually had its floats removed and was fitted with wheels; again the undercarriage gave way—though only when the machine developed tail flutter while undergoing speed tests at Cranwell, and the wheels touched the ground at some 200 m.p.h. Larry Carter sustained injuries.

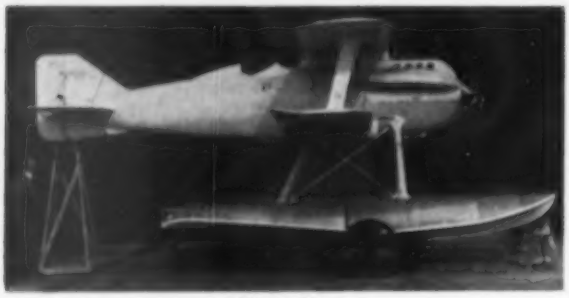
On the Gloster II the *cabane* structure was reinstated, and the radiators were mounted on the front float-struts.

Gloster III For the Schneider contest of 1925 two Gloster III racing seaplanes were constructed, and of these one was flown

Gloster I seaplane.

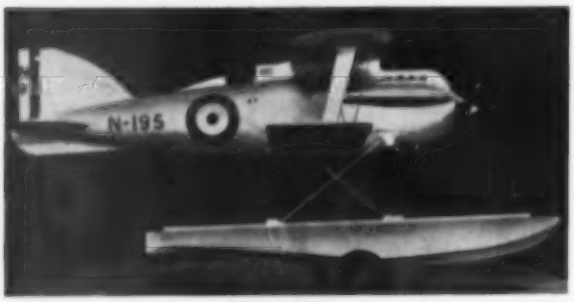
Gloster I seaplane (surface radiators).

Gloster II.



Gloster III.

Gloster IIIA.



Gloster IIIB.

MARS TO JAVELIN . . .

into second place by Capt. Hubert Broad. On that occasion, however, it was not developing by any means its maximum performance, being some 30 m.p.h. slower than the winning Curtiss, piloted by Lt. Jimmy Doolittle. The second machine, with Bert Hinkler as pilot, was made ready for the race as a replacement

Gloster IV (second machine).

for the crashed Supermarine S.4, but was unable to complete the necessary tests in time to participate.

The type was a single-strut biplane with fabric-covered wings and a wooden monocoque fuselage composed of longitudinal members with three-ply skin. The Duralumin floats were made by Short Bros., and Lamblin wing radiators were mounted on the leading edges of the lower mainplanes, as the surface radiators then being developed by the Gloucestershire Aircraft Co. could not be finished in time for the race. The special Napier Lion engine developed some 700 h.p. During the course of development the chord of the upper and lower fins was much increased. Data were: wing area 152 sq ft, gross weight 2,687 lb, maximum speed 218 m.p.h., landing speed 80 m.p.h.

Gloster IIIA This was the designation of Broad's Schneider machine as fitted with a modified tail unit and otherwise improved. Its serial number, while it was on test at Felixstowe, was N194.

Gloster IIIB Numbered N195, this was Hinkler's Schneider machine as modified to have surface radiators on all four wings.

Gloster IV (N224) This was the first of three racing seaplanes bearing the generic name Gloster IV and built for the Schneider contest of 1927. It was a biplane of singularly striking appearance, with the roots of the upper wings fairing down into the lateral cylinder banks of the surface-cooled Napier Lion engine, and the roots of the lower wings curving upwards to meet the fuselage. The wings themselves were of multi-spar construction, covered entirely with laminated spruce, and the interplane struts were built up of Duralumin forgings. The cantilever tail surfaces were made integral with the fuselage, and the fin and rudder, mounted above the fuselage only, were of deep chord.

It had been found on previous Gloster racers that the controls had become extremely sensitive at high speed—so much so that pilots had experienced great difficulty in holding the machines straight and level. Accordingly, the Gloster patent variable-control gear was devised, and was inserted in the control system of the new racer to provide a low-gear ratio for small control movements (as used in the high-speed condition) and a high-gear ratio for large control movements, demanded by the slow-speed case.

The fuselage was an exquisite piece of work, of laminated spruce monocoque construction, built on formers and covered with two skins, laid diagonally to each other. A third layer of spruce was applied forward of the wings, and at all points carrying extra loads there were spruce bulkheads. Twin floats, of Gloster design and of Duralumin construction, were carried on two widely spaced pairs of inverted vee-struts, and the tractor airscrew—also of Gloster design and construction—was of the detachable-blade type, the blades being machined to their correct pitch and contour from a solid Duralumin forging.

The engine of N224 was a special direct-drive Napier Lion VII of some 900 h.p. Wing area was 164 sq ft and length 26ft 4in.

Together with the IVA and IVB, this aircraft served for the training of Schneider pilots for the races of 1929 and 1931, for which purpose the field of view was improved by raising the top wing so that it faired into the top cylinder bank, and by adding a strut-braced centre-section.

Gloster IVA (N222) Such was the wing efficiency of the Gloster IV that it was found possible, in this second machine of the series, to reduce the area by 26 sq ft without raising the landing speed unduly. The new span measurement was 22ft 7½in. Another alteration was the provision of fin and rudder area both above and below the fuselage, the tail unit thus being of cruciform section. N222 was reserve machine in the 1927 Schneider Trophy contest.

This sub-type was prone to high-speed yaw, and early in 1929, together with the IVB, was returned to the Gloster factory to be cured of the fault. The fin and rudder surface below the fuselage was decreased and the area above the fuselage correspondingly increased. A cure was not, however, effected, and eventually the entire fin and rudder area was transferred above the fuselage, as on the original Gloster IV, which had never been afflicted by the same trouble.

Gloster IVB (N223) Generally similar to the IVA, this machine had a geared Lion VIIB engine. It was flown in the 1927 Schneider contest by F/L. Kinkead, who was obliged to retire after achieving a lap speed of 289 m.p.h. Mr. Basil Fielding (now chief inspector at Gloster's Moreton Valence factory, and who was chief inspector at all the Schneider contests) recalls that, after the machine had been towed back to the hangar and the doors had been locked, the airscrew was removed and it was found that the splined airscrew shaft had a crack running three-quarters of the way round it. Had Kinkead not alighted when he did, it could only have been a matter of seconds before the airscrew and shaft broke away completely.

The IVB was, as already stated, returned to the Gloster factory in 1929 for tail modifications. It was eventually crashed, by F/L.

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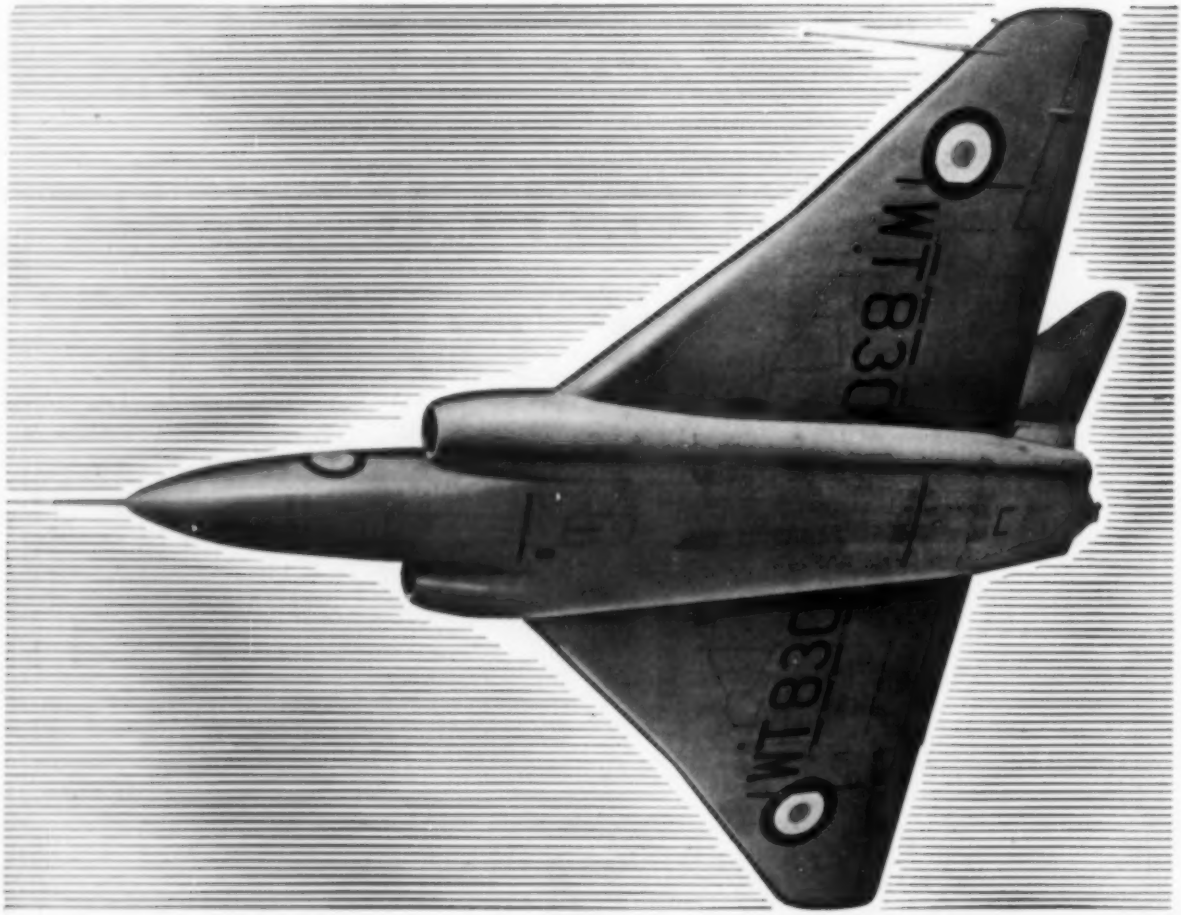


GLOSTER recommend Castrol

MARS TO JAVELIN . . .

Boothman, while alighting in fog. Data for the Gloster IVB were: span 22ft 7½in, wing area 139 sq ft, empty weight 3,215 lb. gross weight 3,300 lb, maximum speed 295 m.p.h., stalling speed 97 m.p.h.

Gloster VI Two of these exceedingly beautiful racing seaplanes, N249 and N250, were built for the Schneider Trophy race of 1929. At the time of their inception Glosters were still claiming that a biplane could be made as fast as a monoplane, and the reason for the adoption of the monoplane layout must go on record. In the early design stage wind-tunnel models of a biplane —the Gloster V—were tested and proved highly satisfactory. Difficulties were encountered, however, when it was discovered that the prescribed Napier Lion VIID engine was almost 300 lb heavier than its predecessors, partly as a result of fitting a supercharger. When a redisposition of the wings was investigated, to allow for the shift in the c.g., it was found that the front spar of the biplane's top wing would come over the centre cylinder block of the Lion, making it impossible to provide an adequate forward view. For this reason the monoplane arrangement was adopted.

Construction was composite, the fuselage being an all-metal semi-monocoque structure, with oval former hoops and Duralumin skin, while the wings were of multi-spar, multi-rib type, built of spruce, and with spruce laminations forming the skin. The floats were of Duralumin. Surface radiators, very much thinner than hitherto used, were fitted to the wing, and the oil was cooled by means of a circular cooler and tank, fitting completely round the fuselage behind the cockpit and lying flush with the skin. Supplementary coolers were let into the upper surface of each float. Painted old-gold, N249 quickly became known as the Golden Arrow. Engine troubles led to its withdrawal from the Schneider contest, but flown by F/L. G. H. Stainforth, it later established a world air speed record of 336.31 m.p.h., attaining a maximum speed on one run of 351.6 m.p.h. On the same day, however, its performance was well and truly beaten by S/L. Orlebar in a Supermarine S.6. N250 was displayed in the New and Experimental Types Park at the R.A.F. Display of 1930 and both machines were used as practice mounts for Britain's Schneider team of 1931. The span of the Gloster VI was 26ft and the length 27ft.

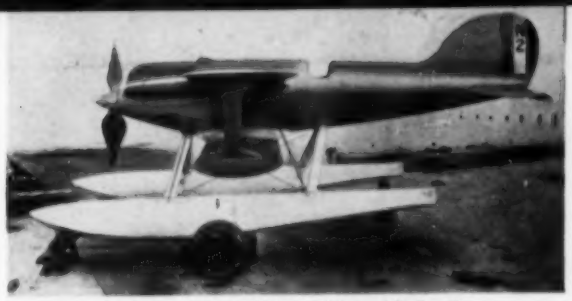
FOR RESEARCH AND TRAINING

Grouse I Although latterly regarded as a trainer, the Grouse —the Mk 1 version of which was fitted with a Bentley B.R.2 rotary engine—was originally built to investigate a novel wing combination. This comprised a high-lift top wing and a medium-lift bottom wing, the latter providing a good measure of lift for take-off but little lift, and consequently little drag, at high speeds. Something approaching monoplane efficiency was thus achieved, with the advantage of a much reduced wing span. A further advantage was that the travel of the centre of pressure was reduced (with consequent gain, it was claimed, in stability) and a short fuselage was made possible. Some indication of the efficiency of the arrangement is given by the following comparison of the Grouse I with the Sparrowhawk fighter, both machines being powered with the same engine. The Sparrowhawk had normal thin biplane wings of R.A.F.15 section, whereas the Grouse had a Gloster HLB1 section for the top wing and HLB2 for the lower. Empty weight of the Sparrowhawk was 1,419 lb and of the Grouse 1,357 lb; so there was a saving in structure weight due to the use of thicker wings. Loaded weights were 2,168 lb and 2,106 lb respectively, and areas 270 sq ft and 205 sq ft—a not inconsiderable reduction. Despite the heavier wing loading, the Grouse had a stalling speed of 47 m.p.h., compared with the 51 m.p.h. of the Sparrowhawk. Top speeds were 125 m.p.h. and 128 m.p.h.

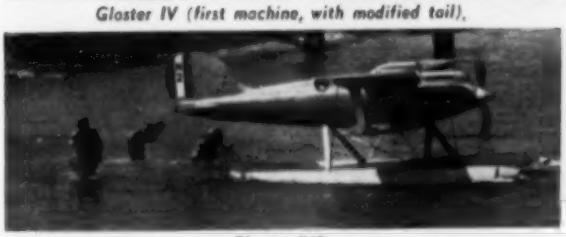
Grouse II This version of the Grouse was powered with an Armstrong Siddeley Lynx radial engine of 185 h.p., and was eventually fitted (possibly under the designation Grouse III) with an oleo undercarriage, similar to that of the Grebe II, and with improved, Grebe-type ailerons. Span was 27ft 10in, gross weight 2,120 lb, maximum speed 120 m.p.h., climb to 10,000ft 17 min, and ceiling 18,000ft. The type was supplied to the Swedish Army Air Force.

A LIGHTPLANE

Gannet For the Light Plane Trials held at Lympne in 1923 Glosters built one of the tiniest aircraft ever to appear in this country. Known as the Gannet, it had a span of 18ft, a length of 16ft 8in, weighed 283 lb empty and 460 lb loaded, and had a wing of 103 sq ft, giving a surface loading of less than 4½ lb/sq ft. An unstaggered biplane, it had a ply-covered fuselage and folding, fabric-covered wings. Particularly remarkable was the specially developed Carden two-cylinder, 750 c.c. two-stroke, vertical, air-cooled engine, which proved, alas, unequal to its task. Subsequently the Gannet was re-engined with a Blackburne inverted vee-twin, and with this unit achieved a speed of 72 m.p.h.



Gloster IV (first machine, with modified tail).



Gloster IVB.

Gloster VI.

Grouse I.

Grouse II (modified).

Gannet.

A.S.31.

Goral.

Goring.

C.16/28.

T.S.R.38.

Mars II (Sparrowhawk I).

MARS TO JAVELIN . . .

FOR AIR SURVEY

A.S.31 In the autumn of 1929 the Aircraft Operating Co., of London, presented the Gloster company with a specification for a special survey aircraft. It was to be a twin-engined landplane capable of being converted to a seaplane if required. Gloster's answer was the A.S.31, their first twin-engined aircraft, and one which proved outstandingly successful. The two Bristol Jupiter XI geared engines were set on the lower wing, the undercarriage was of very wide track, and construction was all-metal. Power was adequate to maintain flight on one engine with full load at 9,000ft, and take-off and landing runs were exceedingly short. Endurance was sufficient to enable areas of the order of 30,000 square miles to be surveyed while the aircraft was operating from a single base. Provision was made for three large cameras in the nose, and the entire floor of the front portion of the fuselage was of glass. Performance exceeded the most sanguine estimates, and when, in March 1930, the A.S.31 was flown out for service with the Zambesi Basin Survey Expedition by Mr. Alan Butler, it completed the 7,000-mile journey at an average speed of 128 m.p.h.—only 3 m.p.h. less than the required all-out level speed. During air survey operations from Bulawayo, with Capt. Robbins as pilot, the machine made a survey of over 60,000 square miles.

A second example of the type was built for the Air Ministry during 1932, and was used for electrical research work.

The A.S.31 had a span of 61ft 6in, was 48ft 6in long, and had a normal flying weight of some 9,000 lb. Its top speed at 1,000ft was 140 m.p.h., stalling speed 47 m.p.h., service ceiling 20,000ft, and endurance 4½-5¼ hr.

FOR GENERAL PURPOSES

Goral Designed by Capt. S. J. Waters, under the direction of Mr. Folland, the Goral was a general-purpose machine, entered for the Air Ministry competition which was eventually won by the Westland Wapiti. Built in 1926, it was fitted with a Bristol Jupiter VI engine. Many units, including the wings, were interchangeable with those of the D.H.9a, and metal construction was used throughout. An unusual feature was that the designers kept prominently in mind the question of repair in countries where facilities for specialized metal work were lacking; thus, all joints were so designed that it was possible to replace a damaged steel member by a wooden one. The following figures were quoted for the Goral as fitted with the Jupiter VIII engine: weight empty 2,885 lb, gross weight, 4,619 lb, maximum speed 141 m.p.h. at 4,000ft, climb to 10,000ft 8.9 min, and service ceiling 21,700ft.

Goring The Goring was a two-seat single-bay bomber/reconnaissance biplane, designed as a private venture, with replacement of the Hawker Horsley in mind. The engine at first fitted was the direct-drive Jupiter VI, but this was later replaced by the geared Jupiter VIII, and eventual installation of the turbo-supercharged Orion was foreseen. The Goring was flown both as a landplane and as a seaplane, and was of notably clean design. A point of special interest was the use of a modified Joukowski aerofoil, giving a high maximum lift. The prototype was mainly of wood, with metal fittings, but all-metal construction was intended. Armament was a fixed Vickers gun, a free Lewis gun, and some 700 lb of bombs, and an alternative split-axle undercarriage was designed to permit the dropping of a light torpedo.

The Goring seaplane was tested by Mr. Rex Stocken and gave excellent results, as indicated by the figures subsequently given in parenthesis. Unbracketed figures relate to the landplane version and both sets apply to the Jupiter VIII installation: speed at 4,000ft, 136 m.p.h. (132); speed at 15,000ft, 122 m.p.h. (119); Climb to 10,000ft, 13.1 min (14.2); landing speed, 51 m.p.h. (49); duration at 15,000ft, 6½ hr (6¼).

A BOMBER TRANSPORT

C.16/28 The largest Gloster aircraft was a four-engined bomber transport built to Specification C.16/28. So large, in fact, was this machine that the doorway of the experimental hangar proved too low to allow removal. Thereupon the works engineer arranged for two trenches to be dug, running out of the hangar and accommodating the undercarriage wheels. This measure, in connection with hand-operated winches, did the trick.

Of 95ft span, the C.16/28 was, in conformity with specification, of all-metal construction. The fuselage was metal-skinned and of fine aerodynamic form, and resistance was further lessened by installing the four Rolls-Royce Kestrel engines in tandem pairs. The main cabin was 27ft 8in long, 7 ft wide and 7ft 3in high—sufficient to take 30 troops and their equipment. For the admission of loads other than troops there was a hatchway in the roof and a trapdoor in the floor. The front engines were Kestrel IIIS and the rear were Kestrel IIS, and each pair was cooled by means of a single condenser unit. Although the aircraft demonstrated a

high performance, it met with tail-flutter problems arising from the servo flaps on the rudders. In the bomber role a maximum load of 6,600 lb could be carried at a cruising speed of 95 m.p.h. Gross weight was 28,500 lb, maximum speed 146 m.p.h. at 12,000ft, landing speed 55 m.p.h., rate of climb at sea level 700ft/min, time of climb to 10,000ft, 17 min, service ceiling 19,000ft.

TORPEDO/SPOTTER/RECONNAISSANCE

T.S.R.38 In November 1930 the company began work on the design of a three-seat torpedo/spotter/reconnaissance aircraft to Specification S.9/30. The engine was the steam-cooled Rolls-Royce Goshawk. Progress was slow, due to the general retarding of aircraft manufacture throughout the country, but towards the end of 1932 the prototype was complete. After initial trials the control circuits were somewhat redesigned, flotation gear was fitted in the wings, and with these modifications the aircraft—now conforming to Specification S.15/33—was duly delivered to Martlesham Heath.

The T.S.R.38 was a good-looking single-bay biplane of all-metal construction with steel spars of dumb-bell section, Duralumin former ribs and high-tensile steel compression ribs. The front fuselage was built up of square-section steel tubes and the rear section was of round steel tubes. In addition to the usual Vickers gun for the pilot and Lewis gun for the observer, an 18in torpedo could be carried beneath the fuselage, as an alternative load to some 1,700 lb of bombs. Full equipment for deck operation was installed. As a torpedo/bomber the machine had a top speed of 150.5 m.p.h. at 3,000ft, stalled at 61 m.p.h., and climbed to 10,000ft in 12.7 min. Service ceiling was 19,500ft.

PISTON-ENGINED FIGHTERS

Mars II (Sparrowhawk I) Thirty of these single-seat fighters were built for the Japanese Navy *circa* 1922. Like other machines of the Sparrowhawk series, the type was essentially a British Nieuport Nighthawk, with a 230 h.p. Bentley B.R.2 rotary engine in place of the 320 h.p. A.B.C. Dragonfly originally fitted. In consequence, performance was much reduced. Top speed was 127 m.p.h. at sea level, 15,000ft was reached in 21 min, and range was 300 miles. Two synchronized Vickers guns were mounted in the top cowling, span was 28ft, length 18ft, and wing area 270 sq ft. A number of Sparrowhawk Is were fitted with Leitner-Watts steel-bladed airscrews.

Mars III (Sparrowhawk II) A two-seater trainer version of the Sparrowhawk I. Ten were supplied to the Japanese Navy. The maker's own Mars III, with a tail resembling that of the Bamel, was flown in the Aerial Derby of 1922.

Mars IV (Sparrowhawk III) A modified version of the Mars II, having a hydrovane undercarriage and flotation gear, to reduce the hazards of "ditching". Top speed was 125 m.p.h. at sea level. Of the ten examples supplied to Japan, some had the Leitner-Watts metal airscrew.

Mars VI (Nighthawk) There were two main variants of the Mars VI (1922) fitted respectively with the Bristol Jupiter IV and Armstrong Siddeley Jaguar III engines. Both were supplied to the R.A.F. in small quantities, though they were never in full-scale squadron service, and the Greek Air Force was supplied with 25 examples of the Jaguar version. In the R.A.F. the same Nighthawk was retained, and it may be said that, on the occasion of the 1922 Aerial Derby, F/L. Bulman came over from Farnborough to give "a magnificent display of stunt flying" on a Nieuport Nighthawk built by the Gloucestershire Aircraft Co., Ltd., and fitted with a 350 h.p. Siddeley Jaguar. F/L. Rollo de Haga Haig and F/O. Chick were other skilful exponents of the type. In Mesopotamia Nighthawks with Jupiter and Jaguar engines were subjected to what would nowadays be known as tropical trials, and one machine, with a forward collector ring for its Jupiter and with an oleo undercarriage also (instead of the former bungee type) was used for special acceleration and incidence tests at the Royal Aircraft Establishment. Performance of the Mars VI was truly outstanding, sea level speed with either engine being about 150 m.p.h. Loaded weight varied between 2,375 and 2,580 lb, and the Jupiter version climbed to 20,000ft in 16½ min.

Mars X (Nightjar) Though the fact is little known, the Nightjar was a standard Fleet Air Arm fighter, 22 having been delivered to the Air Ministry, and used (according to Gloster records) during the Chanak crisis of 1923. The engine was a B.R.2, and the undercarriage was wider in track and longer in stroke than on earlier Mars types. To engage with the fore and aft deck arrester-wires then in use the undercarriage axle fairing carried twin "jaws." Top speed was 120 m.p.h. and time of climb to 15,000ft, 20 min. Today's Naval architects will note with a sigh that the gross weight was 2,165 lb and wing loading 8.3 lb/sq ft.

Mars III (Sparrowhawk II).

Mars IV (Sparrowhawk III).

Mars VI (Jupiter).

Mars VI (Jaguar).

Mars X (Nightjar).

Grebe I prototype.

Grebe II (early production).

Grebe II (modified).

Grebe trainer for New Zealand.

Grebe with Jupiter and v.p. airscrew.

MARS TO JAVELIN . . .

Grebe I Experiments with the wing combination described in connection with the Grouse I (see "For Research and Training"), and a demonstration before Air Ministry officials at Hendon, led to the construction of three single-seat fighter developments of the Grouse, engined with the Jaguar III. The new type was named Grebe (later Grebe I), and was publicly exhibited for the first time at the R.A.F. Aerial Pageant in June 1923. The company's own Grebe, registered G-EBHA, started scratch in the King's Cup Race of that year and did remarkably well until forced to retire with a broken landing wire. Normal speed range was 52-151 m.p.h., the latter figure being realized at 5,000ft. At a flying weight of 2,622 lb wing loading was 10.3 lb/sq ft, and a height of 15,000ft was attained in 12½ min. Two gravity tanks were prominent beneath the top wing, and the armament was two synchronized Vickers guns, with 1,200 rounds of ammunition, and four 20 lb bombs.

Grebe II This was the official designation of the R.A.F. production version of the Grebe I, distinguished by an oleo undercarriage, Jaguar IV engine, redesigned tanks and other refinements. Grebe IIs formed the equipment of Nos. 19, 25, 29, 32 and 56 Squadrons, R.A.F., and in all 130 were built. Following war-time practice, the production order was largely "farmed out," Hawkers making, for example, lower wings, Avros upper wings, and de Havillands ailerons and small parts. Although predisposed to flutter, the Grebe was very popular among Service pilots, and, notwithstanding great sensitivity of control, could be flown hands-off. Top speed at sea level was 152 m.p.h. and at 10,000ft 146 m.p.h.; climb to 20,000ft occupied 24 min, and the absolute ceiling was 23,000ft. Duration, on 52 gallons of fuel, was 2¼ hr at 15,000ft and gross weight was 2,614 lb.

Experimentally flown with a supercharged version of the Jaguar IV engine the Grebe achieved 165 m.p.h. at 10,000ft, and took 16 minutes to reach 20,000ft. Absolute ceiling was 27,000ft. Another non-standard installation of the late 1920s was that of a Bristol Jupiter VI engine, used for experimental flying with a Gloster-Hele-Shaw-Beacham variable-pitch airscrew. The aircraft involved was Gloster's "hack," G-EBHA, which had been flown in the King's Cup Race of 1923, but had acquired, in the meantime, a Gamecock-type tail. The designation Grebe III may have applied to this machine.

With the unsupercharged Jupiter VI, the Gloster-Hele-Shaw-Beacham v.p. airscrew gave a 200ft/min increase in rate of climb, and the difference would have been more marked on a heavier machine with a supercharged engine. Glosters were able to announce with pride that the machine could climb, fly level, loop repeatedly and dive for several thousands of feet without any perceptible variation in r.p.m. The pilot, moreover, could disregard the throttle, leaving both hands free "for gun and aeroplane control," knowing that r.p.m. would not exceed the desired figure.

With a view to improving the pilot's range of vision in fighters subsequent to the Grebe, experiments were made with three modified versions, one having standard wings but with a fined-down centre-section; the second with outer wings faired straight down into the fuselage; and a third with standard wings, but with the centre-section entirely eliminated, leaving a gap of 2ft in the top mainplane. When the tests were concluded in July 1928, it was ascertained that the fined-down centre-section gave the best results in respect of view, climb and speed.

Grebes served, too, for the testing of new armament. Thus, in 1925 one machine of the type was adapted to take Vickers 0.5in guns and a second received twin Colt/Brownings of the same calibre.

During the same year a batch of dual-control Grebe II trainers (Jaguar IIIA) was delivered to the R.A.F. and one of these, flown by F/L. R. L. R. Atcherley, was victorious in the King's Cup Race of 1929 at an average speed of 150.3 m.p.h.

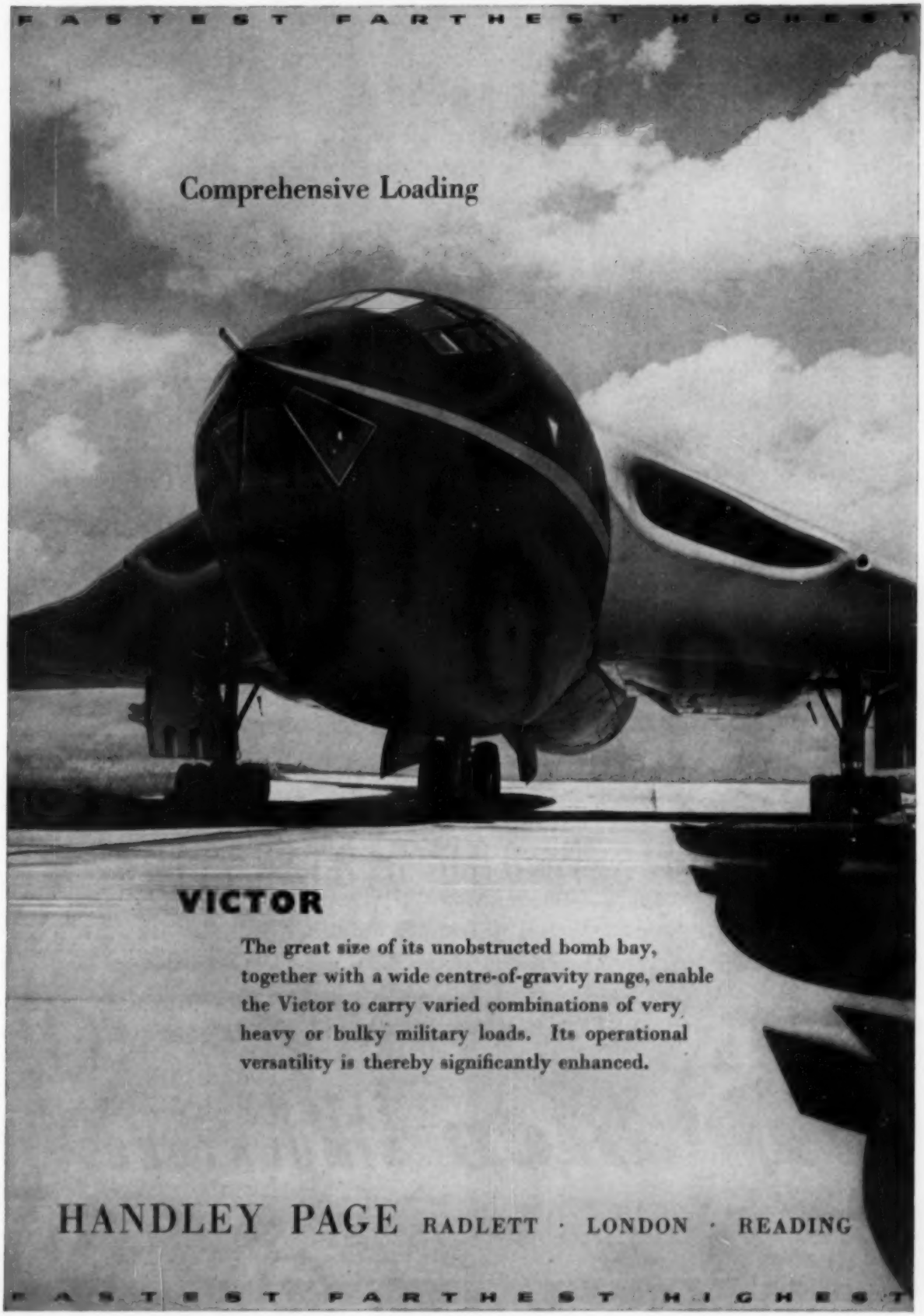
There were dual Grebes, too, among a batch supplied to New Zealand in 1928, although all the New Zealand aircraft were of a much improved type compared with those supplied to the R.A.F. Principally they differed in having new-type narrow-chord ailerons and revised fuselage cowling.

A Grebe is said to have been the first fighter to survive a TV dive—at 240 m.p.h.—at the Aeroplane and Armament Experimental Establishment, Martlesham Heath. Specially modified fighters of this type were employed, too, for an air-launching experiment from the airship R.33 in October 1926. Flown by F/Os. R. L. Ragg and C. Mackenzie-Richards, of the R.A.E., two were released, respectively over Pulham and Cardington. They were suspended from the keel of the airship by a quick-release attachment on the top-wing centre-section, and were braced by struts from the airship's structure to prevent oscillation. Within the R.33 was a Bristol gas starter, connected to the Jaguar engines by flexible piping.

Service-type Grebes were fitted with Gamecock-type ailerons, W/T equipment and—ultimately—with vee struts outboard of the main interplane struts to brace the top wing-extensions.

Gamecock I The first prototype of the Gamecock was delivered to the A. and A.E.E. for official tests in February 1925—seven

Gamecock I (left, R.A.F. type; right, demonstrator).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MARS TO JAVELIN . . .

months after the design was commenced. Though resembling a Jupiter-engined Grebe, it differed in wing dimensions and aileron design, and had a revised fuselage, appealingly "dumpy" in form and accommodating the twin Vickers guns internally and low, instead of more or less externally on top of the engine cowling. At first the tail was of Grebe pattern but by May 1925 had been modified to have a larger fin and a deeper rudder, which was so characteristic of the Gamecock in R.A.F. service. The under-fin, inherited from the S.E.5, was still in evidence, and the tanks were still of the under-wing gravity-feed type.

The Gamecock was generally considered a delightful aeroplane to handle and that past-master aerobat Geoffrey Tyson tells us that it was the first fighter which would do a 360-degree vertical roll, and could still be pushed over the top hanging on its airscrew. It was, however, heir to the flutter troubles of the Grebe and to spinning troubles of its own.

The Gloster pilot charged with investigating the Gamecock's spinning and flutter foibles was Capt. Howard Saint, who eventually dived one of these machines at 275 m.p.h. and completed 22 turns of a spin. Service pilots, including the late "Mutt" Summers, also made a valuable—and valiant—contribution to the Gamecock's development.

Squadrons equipped were Nos. 23, 32, and 43. Gamecocks were flown into the first three places in the 1927 handicap race for the Sassoon Cup, and in the following year another put up the fastest speed. Aerobatic displays by these chubby little biplanes—especially at the R.A.F. Pageants—were never surpassed in their class, and the zestful appeal of their performances was enhanced by the gaiety—even flamboyance—of their squadron, flight and individual markings.

The standard R.A.F. Gamecock I, as described in an official publication of 1927, was powered with a Bristol Jupiter VI and had the following characteristics: Span (top), 29ft 9½in; span (lower), 25ft 11in; length, 19ft 8in; wing area, 264 sq ft; wing loading, 10.85 lb/sq ft; petrol capacity, 60 gal; oil capacity, 6 gal; empty weight (approx.), 1,930 lb; gross weight (approx.), 2,863 lb. The same source quotes a speed of 145 m.p.h. at 10,000ft (this at a gross weight of 2,960 lb), a climb to 10,000ft in 7.6 min, and records that an R.31 receiver and T.25 transmitter were fitted, in addition to two 500 litre oxygen cylinders and a fire extinguisher. Complication was, indeed, setting in!

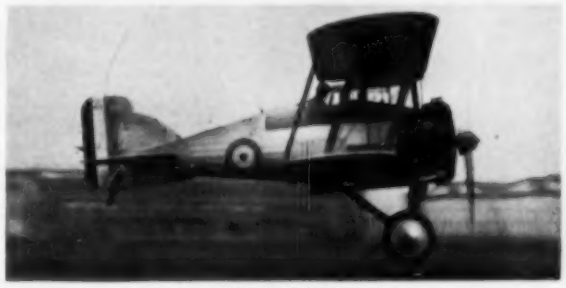
Numerous experimental modifications were made, especially —to improve spinning qualities—to the tail. Latterly R.A.F. Gamecocks had extra centre-section struts and vee struts fitted outboard, to brace the top wing-extensions. Gloster's demonstrator G-EBNT was aerodynamically cleaner, and thus faster, than standard. In 1929 there was an experimental private-venture installation of the unsuccessful Bristol Orion engine, with exhaust-driven turbo-supercharger, in Gamecock G-EBOE. Parallel-chord ailerons were tried experimentally and a Gamecock which had formerly served with No. 23 Squadron was used for the testing of the Vaprog variable-pitch airscrew.

Gamecock II This second mark of Gamecock was built in 1926 and differed from its forerunner principally in wing design. Structurally the mainplanes were almost identical, with the exception that, instead of the two halves meeting on the centre-line of the machine, and being attached to a *cabane*, a centre-section was interposed, supported on struts from the fuselage. This had the double effect of increasing the span of the top mainplane (which had rounded tips) and of greatly improving the pilot's field of view. As a result of the outward displacement of the top planes, the interplane bracing struts were raked outwards. Another change was to be seen in the ailerons, which were of narrower chord, while the struts linking them were moved further outboard, to the centre of the surfaces. The aileron false spars were supplanted by spars running the whole span of the wing, giving a more rigid support for the ailerons, and the petrol tanks were broader, projecting less below the aerofoil section than formerly. The windscreen was redesigned in order to disturb the airflow less, and it was said that the Gamecock II had better control under all conditions.

During 1928 the Gamecock II was successful in a contest held by the Finnish Government and, with the Gnôme-Rhône-built Jupiter, was put into production for the Finnish Air Force. Subsequently the type was built under licence in the Finnish State Aircraft Factory at Helsinki. A ski undercarriage was frequently employed.

Gamecock III This was a remodelled Gamecock I, with a longer fuselage both fore and aft of the wing, and a revised vertical tail. (One form is shown in the photograph.) The ailerons were of the narrow-chord type, as on the Mk II, and the tailplane area was, at one stage, increased. The Gamecock III was used for spinning experiments at the R.A.E. and was later fitted with a Jupiter VII supercharged engine and Gloster-Hele-Shaw-

Gamecock I (Vaprog).



Gamecock II.

Gamecock III.

Gorcock (direct-drive Lion).

Guan.

Goldfinch.

Gambet.

Gnatsnapper I.

Gnatsnapper II.

Gnatsnapper III.

MARS TO JAVELIN . . .

Beacham v.p. airscrew. Eventually it was bought for £25 by a farmer, Mr. J. W. Tomkins, who tells us that he was ultimately allowed to fit a Jupiter VIIFP supercharged engine, presumably ex-Bristol Bulldog. Gamecocks conforming essentially to Mk III standard were built in Finland.

Gorcock Mid-1924 saw Glosters awarded an Air Ministry contract for three experimental single-seat fighters (J7501-3) to be fitted with the water-cooled Napier Lion engine. Two were to have a steel fuselage and wooden wings, and the third was to be all steel. Here, indeed, was an opportunity to exploit their racing experience with the Lion, and in the Gorcock, as the new type was known, the engine was installed with striking neatness, the cylinder banks being subtly faired into the fuselage lines behind the pointed spinner.

Work on the Gamecock had the effect of sidetracking some of the effort from the new machines, and not until 1926 were they being flown to any great extent. At that time interest was running high on the relative merits of geared and direct-drive engines and both types of Lion are said to have been tried. Tests were also put in hand to determine the best form of radiator and air intake, and as a result the wooden-winged Gorcocks were not delivered until 1927. The all-metal specimen delayed a further year. Both versions had flutter troubles, but as research vehicles the three gave undisputed value. As late as 1929 airscrew tests were being conducted with three types of Duralumin airscrew on a Gorcock powered with a Lion VIII direct-drive engine.

The following data were issued by the company during 1927: Span 28ft 6in, wing area 250 sq ft, gross weight 3,049 lb, maximum speed at sea level 168 m.p.h., speed at 20,000ft 149 m.p.h., climb to 20,000ft 18 min. In the following year a Gloster publication printed a set of figures for the "Gorcock II"— possibly the all-metal version—which gave a gross weight of 3,220 lb, speed at 5,000ft 174 m.p.h., and at 10,000ft 172 m.p.h., climb to 15,000ft 10½ min, and ceiling 24,000ft.

Guan A near relation of the Gorcock, the Guan was built for experiments with Napier Lion engines having exhaust-driven turbo-supercharging. Three examples were ordered by the Air Ministry and work began during 1926. By August that year the first machine, with a direct-drive engine, was ready, and was duly delivered to the R.A.E., Farnborough. Shortly afterwards it was followed by the second machine, with a geared Lion. Though speeds as high as 175 m.p.h. were attained at 15,000ft and a service ceiling of 31,000ft was established, the superchargers gave continual trouble and after extensive but unrewarding modification development was abandoned. The fuselages of the two Guans were of steel and the wings of wood. In one installation the Lion maintained its normal power of 470 m.p.h. up to 15,000ft. Gross weight was about 3,355 lb, span 31ft 10in (3ft 4in more than that of the Gorcock), and wing area 298 sq ft. At one stage a Hele-Shaw-Beacham constant-speed, hydraulically operated airscrew was fitted.

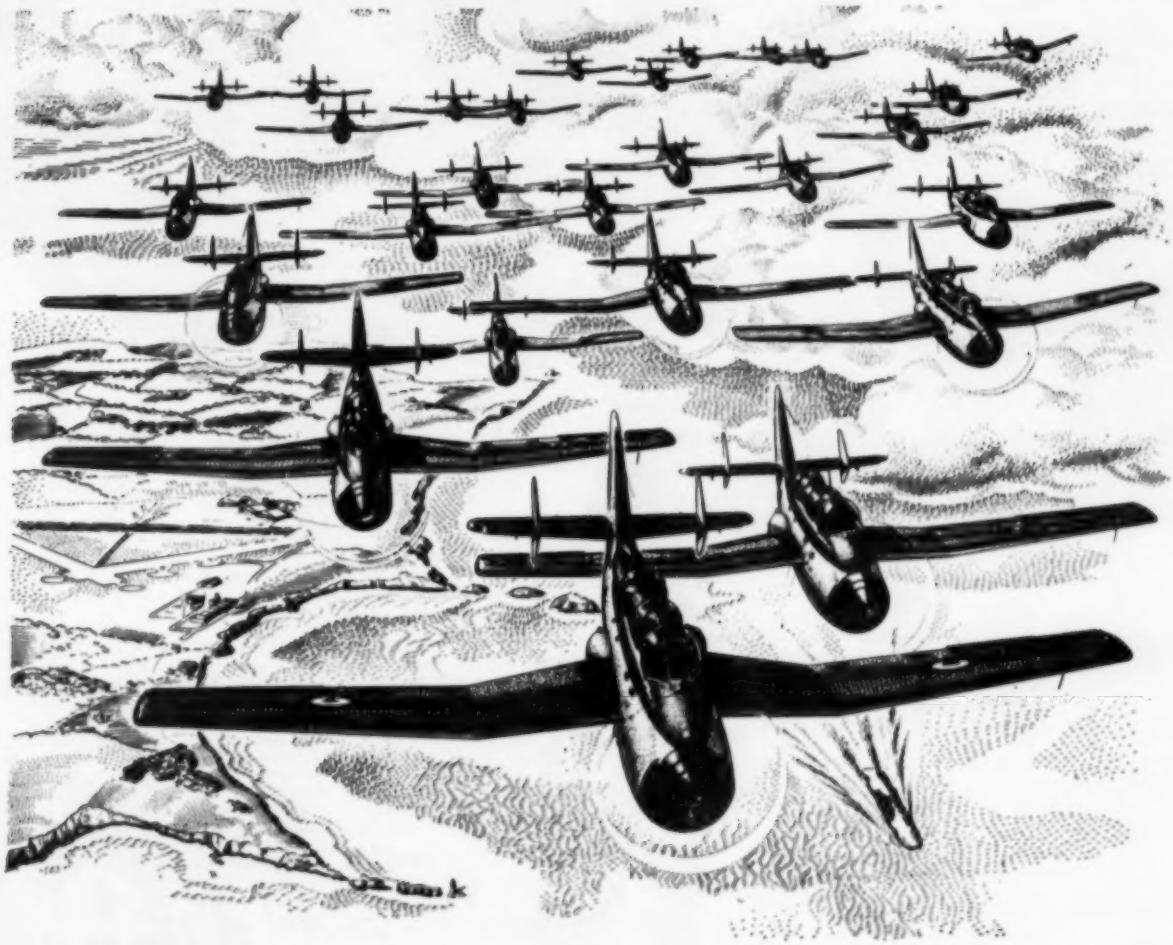
Due to engine-development difficulties the third Guan, which had been intended to receive the inverted, supercharged Napier Lioness, was abandoned before construction began.

Goldfinch There were two distinct forms of the Goldfinch. The first was almost identical in external appearance with the Gamecock II but had metal wings and tail, and possibly fuselage also. An existing photograph of 1928/29 shows this aircraft with rolled steel spars in both wings, although it is said that two designs of high-tensile steel spars were investigated—one of box section, the other of the Gloster lattice steel type. Experimental wings incorporating these two types of spar are said to have been built and test-flown, and though, according to a Gloster statement, it was decided to use the box-section spar in the bottom pair of wings, and the lattice spar in the top pair, this information is at variance both with the photograph referred to and the description of the second type of Goldfinch given subsequently.

The actual Goldfinch which was entered in the day-and-night-fighter competition (wherein it was beaten by the Bristol Bulldog) was considerably different in appearance, having a long fuselage, similar to that of the Gamecock II, a Bristol Jupiter VII supercharged engine, and marked dihedral angle on the top planes. Two types of tail unit were fitted, one similar to that of the standard Gamecock I and II but with a top fin of much deeper chord, and the other resembling that of the Gamecock III.

A description of the Goldfinch issued during 1929 states that the construction was principally of steel, with Duralumin used for portions of the sub-structure and aluminium for the majority of the front fairing and cowling. The front frame of the fuselage was built up of square tubes, rigidly jointed by flat mild-steel plates bolted through the struts and longerons. In the rear frame the struts and longerons were round tubes braced together by tie-rods. Joints were in the form of pressed-steel plates wrapping round the longerons and shaped to house the strut ends. The

More Gannet Squadrons are forming according to plan



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MARS TO JAVELIN . . .

wings were of high-tensile steel construction, with the Gloster type of lattice-girder spar in the thick upper wing, and, in the thinner lower wing, a rolled high-tensile-steel-strip spar having continuous webs. Following the usual Gloster practice, petrol tanks were fitted into each of the upper wings. The specification called for two Vickers guns, wireless equipment (weighing 25 lb!), and night-flying gear. The span of the top wing was 30ft, and of the lower, 27ft 10in. Length was 22ft 3in and wing area 274.3 sq ft. At 10,000ft the top speed was 171.5 m.p.h. and at 20,000ft 157.5 m.p.h. The climb to 20,000ft took 16.2 min, service ceiling was 26,900ft, landing speed 56 m.p.h., and endurance at 15,000ft 2.78 hr. Gross weight was 3,236 lb. (The foregoing figures were issued in 1929 and differ somewhat from those published in *Flight* during October 1928.)

Gambet When the Sparrowhawks of the Japanese Navy began to fall due for replacement a ship's-fighter competition was organized in Japan with a view to selecting a new type. Glosters were naturally determined that the order should again come their way, and busied themselves in July 1927 in the design of a new naval fighter, of wooden construction, called the Gambet. The prototype, with a Jupiter VI engine, was completed in December, was entered in the competition by the Mitsui company, and quickly proved superior to its rivals. Mitsui eventually secured the design rights and under the designation Navy Type 3 the Gambet was licence-built in Japan. The wing cellule resembled that of the Guan in that the top wing measured 31ft 10in in span. Outboard of the interplane struts the top-plane extensions were wire-braced. Gross weight was 3,075 lb, maximum speed 152 m.p.h. at 5,000ft, and the climb to 15,000ft took 11 min. Ceiling was 23,000ft, landing speed 49 m.p.h., and endurance 3¼ hr at 15,000ft with full load. Arrester hooks were attached to the axle of the undercarriage, and provision was made for flotation bags in addition to night-flying gear, two Vickers guns with 1,200 rounds of ammunition, and four 20 lb bombs.

As a footnote it may be remarked that at least one Gambet was used during the 1930s as a mail carrier on Japanese routes, and in this capacity it was fitted with a cockpit enclosure.

Gnatsnapper I To Specification N.21/26, which called for an all-metal, carrier-borne, single-seat fighter, powered with a Bristol Mercury engine, Glosters built the Gnatsnapper I—a single-bay biplane of 33ft 6in span and 24ft 7in length, with a wing area of 360.5 sq ft and weighing 3,800 lb all-up. The specified engine was a Mercury IIA which, in the words of the Gloster company, "was rather a nebulous quantity and, in addition to weighing more than 15 per cent heavier when delivered than when originally designed, failed to give satisfaction, being unable to stand up to the work it was required to do." A Jupiter was fitted at one stage, but trouble with the Mercury left no time for the Gnatsnapper to be entered in the ship-fighter competition; eventually it checked in at Martlesham Heath in May 1929—after no fewer than eight changes of engine installation, it is said. As a flying machine the Gnatsnapper was very satisfactory in respect of performance, manœuvrability and diving qualities. At an early stage a special set of wings, having double-camber flaps, was tried.

Gnatsnapper II Difficulties with the Mercury engine led the Air Ministry to hold a second competition for naval single-seat fighters, and Glosters were given instructions to proceed with redesign of the Gnatsnapper to take the Armstrong Siddeley Jaguar VIII—a 14-cylinder geared and supercharged radial. With the new power unit Gnatsnapper N227 (now the Gnatsnapper II) was delivered to Martlesham Heath during the first half of 1930. At first the Jaguar engine was uncowled but was later fitted with a Townend ring. With the latter installation the machine ultimately had a tail unit similar in outline to that of the S.S.18 intercepter.

At its gross weight of 3,800 lb the Gnatsnapper II attained 181 m.p.h. at 14,500ft and climbed to 20,000ft in 19½ min.

Gnatsnapper III (S.S.35) This third version of the Gnatsnapper—again the familiar N227—was fitted with a Rolls-Royce Kestrel IIS steam-cooled engine and a two-bay wing cellule having steam condensers along the leading edges of upper and lower mainplanes. At one time the tests with the evaporative system were considered to be so promising that it was proposed to embody this as a standard feature on future Gloster fighters, but this was not to be. During 1934 the Gnatsnapper III was serving at Hucknall as a Rolls-Royce "hack."

S.S.18 Checkered as was the career of Gnatsnapper N227, it was quite uneventful in relation to that of another Gloster fighter, serial-numbered J9125. The number first appeared on a land-based intercepter-fighter biplane, designed to Specification F.20/27 and powered with a Bristol Mercury IIA engine. Reversion to the two-bay wing formula, with its greater number of drag-producing struts and wires, was especially interesting in

S.S.18.

S.S.19.

S.S.19A.

view of the fact that one of the primary requirements of an intercepter was very high speed. But so clean was the fuselage, and detail design generally, that the new fighter proved very fast indeed, despite the extra wing-bracing. Moreover, the wing structure was very rigid in the dive and allayed the flutter worries which had attended the development of some of the earlier single-bay Gloster machines.

The new fighter was designated S.S.18 and was of all-metal construction. The fuselage was made in three sections, of which the front portion formed the engine mounting, the middle section included the cockpit, with fuel tanks, etc., and the rear portion carried the tail. The engine was mounted on a bearer comprising eight round steel tubes, attached to the four longerons by socketed ends. The centre part was of square tubes, the joints being formed by simple plate fittings. In the rear portion round tubing was used, with joints of the standard Gloster pressed-plate type. From the engine aft to the cockpit the fuselage was faired off by metal panels, and behind the cockpit there was fabric covering over a light, metal structure. The wings each had two main spars of high-tensile steel, with steel ribs. Ailerons were of the Frise type and were so arranged that their control levers did not project beyond the wing surface. Fabric was attached by a Gloster patented wired-on method, placed in position together with a layer of tape, when rustless wire was threaded through eyelets formed in the rib, and was locked under the heads of the bolts attaching the leading and trailing edges. An advanced feature at the time was the fitting of wheel brakes, which could be operated either by pedals on the rudder bar or from the control stick.

Span was 32ft 9¼in, length 25ft 9in, wing area 332 sq ft and gross weight 3,270 lb. Armament was two Vickers guns firing through troughs in the fuselage sides.

S.S.18A The shortcomings of the early Mercury engine, to which allusion has already been made, led to the installation in airframe J9125 of a Bristol Jupiter VII, this installation being signified by the suffix "A" in the aircraft designation.

S.S.18B The suffix "B" signified the installation—still in J9125—of an Armstrong Siddeley Panther III engine.

S.S.19 A further development of J9125, with Bristol Jupiter VIIF engine, but with six machine guns—two Vickers guns, with 600 rounds apiece, in the fuselage, and four Lewis guns, each with a 97-round drum, in the upper and lower wings. The guns were arranged to give a "cone of fire," the streams of bullets converging 150 yd ahead of the aircraft. Notwithstanding the extra

S.S.19B

Gauntlet IIs.

F.7/30.

MARS TO JAVELIN . . .

weight of the armament, performance remained excellent. Official Martlesham figures were: maximum speed 170 m.p.h. at sea level, or 188 m.p.h. at 10,000ft, rate of climb at 1,000ft 1,800ft/min, or at 10,000ft 1,600ft/min, time of climb to 20,000ft 15 min 14 sec, take-off run 125 yd, landing run 170 yd, landing speed 57 m.p.h., terminal velocity diving speed 320 m.p.h. The excellent performance was due in some measure to the fitting of a Townend ring over the engine.

S.S.19A This was the S.S.19 six-gun fighter with its Lewis guns removed, with day-and-night-fighter load and revised tail.

S.S.19B (Gauntlet) At the S.B.A.C. Display in 1933 Glosters introduced their new day-and-night-fighter version of J9125, with the Mercury IVS 2 engine, designated S.S.19B. Thus modified the aircraft was entered in a day-and-night-fighter competition held with the object of finding a replacement for the Bristol Bulldog in R.A.F. service, and the following certified extract from Martlesham Heath Report M/572/3, dated August 1933, appeared in *Flight* during December of that year. It applied to the "S.S.19B single-seater day and night fighter aircraft recently named the Gauntlet": "All-up weight, 3,858 lb; tare weight, 2,704 lb; climb to 1,000ft, 32 sec; 5,000ft, 2 min 42 sec; 10,000ft, 5 min 24 sec; 15,000ft, 8 min 12 sec; 20,000ft, 11 min 43 sec; service ceiling, 33,350ft. Speed at sea level, 169.5 m.p.h.; 5,000ft, 184.5 m.p.h.; 10,000ft, 199.5 m.p.h.; 15,000ft, 214 m.p.h.; 16,500ft, 215.5 m.p.h.; 20,000ft, 212.5 m.p.h.; stalling speed, 54 m.p.h." It was further reported that diving tests had been made at a weight of 3,550 lb. Figures for two dives were given. In one, commenced at 20,000ft, a maximum A.S.I. of 275 m.p.h. was attained at 13,000ft. The height at commencement of recovery was 12,000ft, and level flight was regained at 9,800ft.

Towards the end of 1933 a "development order" was placed by the Air Ministry for sufficient Gauntlets to equip one R.A.F. squadron.

Gauntlet I In the spring of 1934 *Flight* announced that the Gauntlet had lately been engined with a Bristol Mercury VIS, fitted with the new-type combined exhaust collector and Townend ring. Other refinements included Dowty legs for the undercarriage and a tailwheel in place of the skid. During June 1934 Glosters issued a summary of performance, giving a top speed at 15,800ft of no less than 228 m.p.h. Stalling speed was only 59 m.p.h., climb to 20,000ft occupied a mere 9 min, service ceiling was 35,500ft, and the all-up weight 3,950 lb. The airframe was still J9125. So remarkable were the figures achieved that the aircraft was placed in the 24ft tunnel at the Royal Aircraft Establishment to ascertain if its performance could be attributed to any particular aerodynamic feature. As estimated from the tunnel drag tests and engine test-bed power the top speed was 234 m.p.h. at 15,000ft. Actual measured speed was 230 m.p.h.

Mr. Folland himself ascribed the Gauntlet's performance to the following factors: (a) development of a pure streamlined fuselage and the fitting of the structure and equipment into the developed shape; (b) the introduction of thin wing sections; (c) enclosure within the wings of all bracing-wire fittings so that only streamlined wires appeared through the fabric; (d) deletion of all external control levers; (e) the attention paid to interferences between the centre-section and fuselage, the fairing off of the wing into the body and of the struts into the wings; (f) the use of pure streamlined wires instead of oval wires; (g) the introduction of streamlined undercarriage wheels; (h) care in the design of all detail fittings.

As it first went into service with the R.A.F.—with No. 19 Squadron during May 1935—the aircraft was designated Gauntlet I, and this name covered aircraft with Service numbers K4081-K4104.

Gauntlet II Gauntlets K5264 onwards had Hawker-type spars, and consequently new struts and bracing; a Hawker-type rear fuselage of square-section tube with Warren-girder bracing in the side bays; and Simmonds-Corsey engine controls. These aircraft were designated Gauntlet II. The Mercury VIS engine was retained, but some Gauntlet IIs had Fairey three-blade fixed-pitch metal airscrews.

During the period 1936-37 a total of 204 Gauntlets were built, including one for Denmark. Seventeen additional machines were built under licence in Copenhagen. Official figures for the Gauntlet II were: Gross weight 3,970 lb, maximum speed 230 m.p.h. at 15,500ft, stalling speed 59 m.p.h., time of climb to 20,000ft 9 min, service ceiling 33,500ft.

F.7/30 As a private venture, to Specification F.7/30, Glosters produced during 1934 a cleaned-up development of the Gauntlet, having the works designation G.37 and armed with four guns (two Vickers in the fuselage and two Lewis in the lower wings). The Mercury VIS engine was retained, but a new single-bay wing cellule was introduced, together with a cantilever single-strut undercarriage utilizing Dowty internally sprung wheels. The new fighter was being subjected during 1935 to competitive tests, and in July it was announced that an order had been placed for sufficient aircraft to equip an R.A.F. squadron. The name Gladiator was thereupon conferred.

Gladiator I During the course of development the Gladiator was re-engined with a Bristol Mercury IX, in a medium-chord cowling. The cockpit was enclosed, and the armament was changed to four Browning guns. In this, its production form (Specification F.14/35), it was described in *Flight* early in 1937. The following figures were given: Span 32ft 3in, length 27ft 5in, wing area 323 sq ft, maximum speed 253 m.p.h. at 14,500ft, climb to 20,000ft 9 min, empty weight 3,476 lb, normal gross weight 4,640 lb.

Our account ran: "The biplane wing arrangement of the Gladiator is along orthodox lines, with single-bay bracing. Rigging is facilitated by having special fine-adjustment turn-buckles only at the lower ends of the streamline wires. One unusual feature is provided by the trailing-edge flaps, a modern touch not usually found on biplanes. These flaps are quite small and are fitted on both upper and lower wings. They serve to increase drag rather than to increase lift, although there is a difference in stalling speed of 6 m.p.h. between flaps-up and flaps-down minima, the actual figures being 59 m.p.h. and 53 m.p.h. respectively. For making landings at night, the advantage of being able to steepen the approach angle is obvious. The flaps are operated in a hydraulic pump. An interesting wing detail is the use of strut-foot cuffs made of Plastilume-moulded Celastoid. The Bristol Mercury engine drives a wooden two-bladed airscrew in the standard production Gladiator, although one batch has been fitted experimentally with Fairey three-bladed metal airscrews."

The designation Gladiator I was officially conferred on this first production version.

Gladiator II This was a late-production version of the Gladiator, to Specification F.36/37, powered by the shadow-built Mercury VIIIA engine, with automatic-mixture-control carburettor and Hobson control box; having a flying-instrument panel with a vacuum pump; desert equipment; sand excluders and a

Vokes air cleaner; and a large accumulator for electric starting from the cockpit.

R.A.F. squadrons equipped with Gladiators (Mks I and/or II) were Nos. 3, 17, 33, 54, 56, 65, 72, 73, 80, 223 and 224. Auxiliary squadrons were Nos. 602 (City of Glasgow), 603 (City of Edinburgh), 607 (County of Durham), and 615 (County of Surrey). In all, 527 of these excellent fighters were built, of which 216 were exported in the following quantities: Belgium 22, China 36, Greece 2, Finland 30, Iraq 15, Irish Free State 4, Latvia 26, Lithuania 14, Portugal 30, Norway 12, and Sweden 25.

The last Gladiator II was completed early in 1940, and was delivered in April of that year. This was the final biplane fighter to be used on operations by the Royal Air Force.

Sea Gladiator During 1938 a carrier-borne fleet-fighter version of the Gladiator was designed, and eventually 60 such aircraft, with the name Sea Gladiator, were built. The engine was the Mercury IX or VIIIA, and the principal modifications were the addition of an arrester hook and a dinghy (carried in a fairing beneath the fuselage). Empty weigh was 3,745 lb, gross weight 5,420 lb, maximum speed 245 m.p.h. at 15,000ft, cruising speed 212 m.p.h. at 15,500ft, service ceiling 32,000ft, and range 425 miles.

Non-standard Sea Gladiators were *Faith*, *Hope* and *Charity*, heroic defenders of Malta, whose story is told at length in a book titled with their names. Therein it is related how ex-Blenheim Mercuries, with variable-pitch airscrews, were pressed into service in these aircraft, how the throttle gate was opened to secure the ultimate in performance, and how guns were mounted on the top wing.

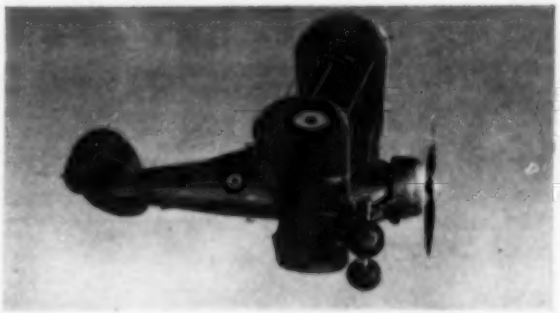
F.5/34 This was Gloster's first monoplane fighter, and was designed to the same specification—F.5/34—as the Hurricane and Spitfire. Its armament was, therefore, eight 0.303in Browning guns, mounted in the wings. Construction was entirely in metal, the fuselage being a light-alloy monocoque structure. The wing had hydraulically operated split flaps and fabric-covered Frise ailerons. Although the Dowty undercarriage was retractable (folding backwards into the wings), a large segment of each wheel was left protruding, and it was so arranged that the wheels should take the full weight of the machine in the event of a wheels-up landing. A portion of the tailwheel also was left protruding for the same purpose. Glosters admit that this arrangement may now seem to have been rather drastic, but at the time considered it a small price to pay in performance for the measure of safety afforded. The engine of the F.5/34 was a Mercury IX, with a long-chord cowling, leading-edge exhaust collector and adjustable gills. The airscrew was a three-blade controllable-pitch de Havilland. Span was 38ft 2in, length 32ft, wing area 230 sq ft, gross weight 5,400 lb, wing loading 23.4 lb/sq ft, maximum speed 315 m.p.h. at 16,000ft, stalling speed 68 m.p.h., climb to 20,000ft 11 min, service ceiling 32,500ft.

Although design studies had commenced as early as 1935, the first of two F.5/34s built, numbered K5604, did not appear until December 1937, due to the company's preoccupation with Gauntlets and Gladiators. By that time, of course, the Hurricane and Spitfire were both in production and Glosters were not awarded a contract. The second machine was completed and flown in March 1938.

F.9/37 (Taurus engines) During 1935 Glosters were designing, to Specification F.34/35, a twin-engined two-seat fighter, mounting a four-gun turret. As earlier specification, F.9/35, had called for a single-engined machine with similar armament, and when it was found that the Boulton Paul Defiant, designed to this requirement, promised to have a performance which would meet both specifications, the Gloster F.34/35 project was abandoned. Some eighteen months later, however, another specification, F.9/37, was issued, calling for a twin-engined single-seat fighter with fixed armament, and to its requirements Glosters submitted a design based on their earlier project. The machine having been planned originally as a two-seater, performance suffered a slight handicap on that account, but when the first F.9/37 (serial number L7999) flew on April 3rd, 1939, it was seen to be a fighter of great merit. Construction was all-metal and the engines were two Bristol Taurus TE/1 fourteen-cylinder radials. The pilot was seated in the very forefront of the fuselage, and the armament was two 20 mm Hispano guns mounted in the nose, and four 0.303in Browning guns, installed aft of the cockpit and firing forward past the cockpit. Span was 50ft, length 37ft, wing area 386 sq ft, empty weight 8,826 lb, gross weight 11,615 lb, wing loading 30.1 lb/sq ft, power loading 6.5 lb/sq ft, fuel capacity 170 gallons, maximum speed 360 m.p.h. at 15,000ft, rate of climb at 12,000ft 2,460ft/min, and service ceiling 30,000ft.

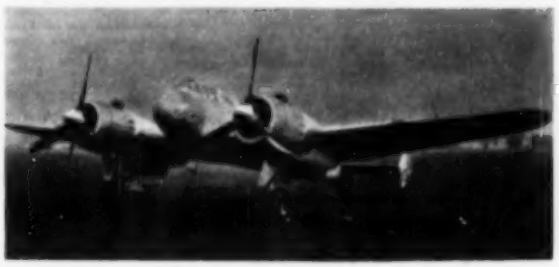
The L7999 prototype completed early flight trials at Brockworth and was eventually delivered to the R.A.F. After suffering a landing accident, it was returned to Brockworth for rebuilding, and in the course of this work was re-engined with the lower-powered Taurus III engines (giving 900 h.p. whereas the Taurus TE/1 gave 1,050 h.p.), which reduced the maximum speed to 332 m.p.h. at 15,200ft. Trials were completed in July 1940.

Gladiator

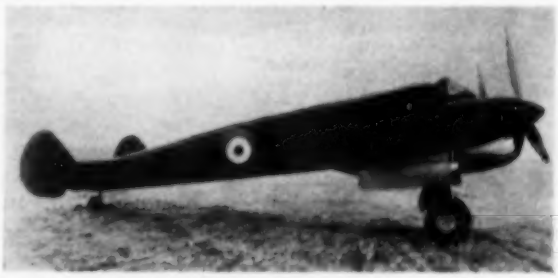


Sea Gladiator.

F.5/34.



F.9/37 (Taurus).



F.9/37 (Peregrine).

F.9/37 (Peregrine engines) The second F.9/37, number L8002, had two Rolls-Royce Peregrine liquid-cooled engines of 885 h.p. First flown in July 1940, it achieved a maximum speed of 330 m.p.h. at 15,000ft. In common with the Taurus-engined machine, it was remarkably manœuvrable and docile.

E.28/39.

MARS TO JAVELIN . . .

E.28/39 (modified).

F.9/40.

F.9/40 (Metrovick).

Meteor I.

Trent-Meteor.

PIONEER JET

E.28/39 The E.28/39 was the first British jet-propelled aircraft to fly. The contract was placed on February 3rd, 1940, and its primary object was to flight-test the engine installation, though it was specified that the design should be based on requirements for a four-gun intercepter. Two airframes were put in hand, and as the first, W4041, neared completion, it was transferred from the Gloster works at Brockworth to a garage at Cheltenham to lessen the chances of destruction in an air raid. Early in April 1941 the machine was taken to Brockworth for taxying trials, and on May 15th the first flight was accomplished by F/L. P. E. G. ("Jerry") Sayer. The engine on that occasion was the Power Jets W1 or "Whittle Supercharger Type W1", as it appeared on the first flight test report, reproduced in *Flight* of October 27th, 1949.

Design of the fuselage was a formidable task, and in order that the risks involved should be minimized, a simple straight-through power installation was adopted. The W1 was mounted in the rear fuselage and in the nose was a circular intake, split into two ducts, which followed the fuselage sides of the plenum chamber. The W1 itself had ten combustion chambers of reverse-flow type, to which air was fed by a double-sided aluminium-alloy centrifugal compressor. Paraffin was injected by ten Lubbock burners, and the products of combustion energized a single-stage turbine. At its maximum permitted r.p.m. of 16,500 (above 4,000ft this figure was increased to 17,750) the unit produced 860 lb of thrust.

The fuselage was of metal monocoque construction throughout and contained an 81-gallon fuel tank between the turbojet and the cockpit. The wing was of two-spar construction; the ailerons were fabric-covered, and hydraulically operated split trailing-edge flaps were fitted. For the first series of flight tests the aerofoil was of 230-series section, but all further tests were made with "high-speed" G.W.2-section wings. To compensate for the loss of airscrew slipstream effect at low airspeeds the elevator was of uncommonly large area. The Dowty nosewheel undercarriage took full advantage of the low ground clearance made possible by the absence of an airscrew. In early tests, flying at an all-up weight of 3,690 lb, endurances as great as 56 minutes were recorded, but no more than 2g could be applied due to the low stressing of the W1 compressor casing. For the second series of tests, in February 1942, the W1A was installed, and it was at this stage that the "high-speed" wings were fitted, though the only noticeable effect on performance was a stalling speed 4 m.p.h. higher.

The second E.28/39, W4046, was fitted with the Rover-built W2B, bearing the maker's designation B.23. The thrust of this unit rose, during the course of development, from its original 1,000 lb to 1,700 lb. The first flight of the second machine was on March 1st, 1943, and the greatest speed attained by this machine was 466 m.p.h., a figure recorded on a flight from the R.A.E. with a W2B of 1,526 lb thrust. On July 30th, while on a high-altitude test, the ailerons jammed, and the pilot, S/L. D. Davie, baled out safely from 33,000ft.

Meanwhile, the original W4041 had been returned to Brockworth for the installation of a Power Jets W2/500 of 1,700 lb thrust, which Michael Daunt reported to be "the smoothest unit that this pilot has had the pleasure of flying". On June 24th, 1943, a height of 42,170ft was attained by John Grierson, who took off before breakfast after inhaling pure oxygen for thirty minutes. The E.28 cockpit was unpressurized, but Grierson wore a pressure waistcoat. Next day John Crosby Warren concluded the Gloster team's work on the machine, and towards the end of 1943 it was transferred to the R.A.E. for a final ten-hour test programme conducted early in 1944. Its great task completed, W4041 was retired, and on April 27th, 1946, was given a permanent home in the Science Museum, South Kensington. Dimensions of the E.28/39 were: Span 29ft, length 25ft 3in, height 9ft 3in.

THE METEOR FAMILY

F.9/40 Many months before the E.28/39 had made its first flight, Mr. Carter had considered the design of a new jet-propelled fighter. At the time—1940—the ultimate thrust foreseen from any unit in prospect was about 2,000 lb. Clearly this was insufficient, and the design of a twin-jet machine was postulated. Having considered various layouts, Mr. Carter decided to mount the jet units on the wings, and to fit them in between the spars. Air was to be taken in above and below the front spar, and the jet-pipe would pass through a "banjo" in the rear spar. The armament originally specified was six 20 mm guns, each with 120 rounds, but was later changed to four guns with 150 rounds apiece. Glosters submitted their proposals to the Ministry of Aircraft Production, who issued, during November 1940, Specification F.9/40, which covered the design. February 1941 saw the placing of a contract for twelve prototype F.9/40s, and of these eight were ultimately built.

The first of the F.9/40s was DG202/G, powered with two Rover W2B turbojets of 1,000 lb thrust each at 15,000 r.p.m.

Under the heading "Altitude Restrictions" an entry on the Limitations Sheet read: "The engines must not leave the ground"; but on July 10th, 1942, taxying trials were initiated at Newmarket Heath, and Jerry Sayer made a few short hops. He recommended that engines of more thrust be made available before the first true flight.

A great amount of development work of the W2B was entailed and matters were so delayed that the de Havilland H.1 units (prototypes of the Goblin) were ready to take the air before the new Rovers. During this period Sayer was killed in a Typhoon, whereupon Michael Daunt took over the flying programme, and accomplished the first true flight in an F.9/40 on March 5th, 1943. The aircraft was DG206/G.

The principal engine and design changes were as follows: airframe DG202/G was re-engined with Rover B.23s, of 1,526 lb thrust; the second prototype, DG203, was tried with Power Jets W2/500s, of 1,640 lb thrust and W2/700s of 2,000 lb thrust, and had a pressure cabin; DG204/G had Metrovick F3/1s, of 2,000 lb thrust; DG205/G had Rover W2Bs and Rolls-Royce B.23s, of 1,400 lb thrust, and special flat ailerons; DG206/G, which, as we have related, was the first to fly, had Halford H.1s; DG207/G was similarly powered and had a pressure cabin; DG208/G was fitted with Rolls-Royce WR1s of 1,600 lb thrust, and with full operational equipment, and increased rudder area; and DG209/G, the eighth prototype, had Rolls-Royce B.37s (early Derwents), of 2,000 lb thrust.

Meteor F.1 A production order for the F.9/40 was placed in September 1941 and the name Thunderbolt was allocated. To avoid confusion with its Republic namesake, however, the type was officially named Meteor in March 1942. Twenty Meteor Is were built and the standard power units were two Rolls-Royce B.23c (Welland) turbojets. There were no air brakes, and the canopy opened sideways, as on the F.9/40. Gross weight was 13,800 lb. In exchange for a Bell Airacomet, the very first production machine (EE210/G) was delivered to the U.S.A. by John Grierson, as related so engagingly by Mr. Grierson himself in his book *Jet Flight*. Though not fully operational, two machines of the type were delivered to No. 616 Squadron on July 21st, 1944, and five full effective examples followed on July 23rd. The first confirmed victory was on August 4th, when F/O. Dean, in Meteor I EE216/G, caused a V.1 flying bomb to crash.

One Meteor I airframe was converted to take two Rolls-Royce Trent turboprops (see under "Trent-Meteor"); EE212/G had reduced rudder area and no under-fin; EE214/G had a fixed ventral tank of 100 gallons capacity and of steel construction; EE215/G was the first jet fighter flown with jet-pipe reheat (top speed was increased thereby from 420 m.p.h. to 460 m.p.h.); EE219/G had auxiliary fins fitted to the tailplane; EE221/G had a jettisonable steel 100-gallon tank; EE223/G was the first Meteor to have pressurizing and was used by Rolls-Royce as a development aircraft; and EE227/G had no fin and rudder surface above the tailplane.

Trent-Meteor On September 20th, 1945, the world's first turboprop aircraft made its first flight. It was a Meteor I, serial number EE227/G, which had been adapted to take two Rolls-Royce Trent turboprops. This machine was flown by the Editor of *Flight* early in 1948, and as a result he wrote: "The Meteor airframe is an old Mk I with hinged cockpit enclosure and long undercarriage to give airscrew tip clearance, and the Trents are purely development units comprising pure-jet Derwent IIs to which have been fitted shafts and reduction gearing in order that a proportion of the power may be absorbed in airscrew thrust. Power output is made up from 750 s.h.p. and 1,000 lb thrust. As a result of modifications, the Trent-Meteor is heavier than any of the standard marks." He went on, "Although the Trent airscrews are not handed, there was no tendency to swing on opening up, and the thrust has to be experienced to be believed. As take-off r.p.m. build up, one is hurtled down the runway and off the ground. The push in the back is tremendous, and as soon as the machine is off, with the wheels up, it can safely be pulled up into an alarmingly steep climb." He concluded his report thus: "Except for the very high air speeds, the airscrew-turbine has many good features, very few inherent disadvantages, and most of its control problems are well on the way toward satisfactory solution, thanks, to a great extent, to the timely work of the Rolls-Royce company with their Trent-Meteor."

Meteor F.2 Only one Meteor of this mark was built. It differed from the Mk 1 in having de Havilland Goblin turbojets of 2,000 lb thrust each. The first flight was in March 1943, and for a lengthy period thereafter the machine was used by the de Havilland company for development flying with various models of the Goblin.

Meteor F.3 This was the first version of the Meteor to be produced for the R.A.F. on any large scale. The prototype flew in September 1944, and first deliveries were made some four months later to No. 616 Squadron of 83 Group, 2nd T.A.F. The second unit was No. 504 Squadron. Sparse air-to-air enemy opposition at the time caused the Meteors to be employed principally for ground attack. Initially Rolls-Royce Wellands were installed, but later deliveries were engined with the Derwent 1. The final fifteen had lengthened nacelles. Other items introduced on the Meteor 3 were a sliding-type canopy; slotted air brakes (these were cleared for operational use, whereas on earlier marks they were not); a ventral drop tank; and metal control surfaces. Top speed was about 460 m.p.h. at sea level and 475 at 10,000ft. Gross weight was 12,500 lb and span, as on all previous Meteors was 43ft. Meteor 3s were engaged on the first tropicalization trials of jet aircraft—at Khartoum in September 1945—and on the

Meteor F.3.

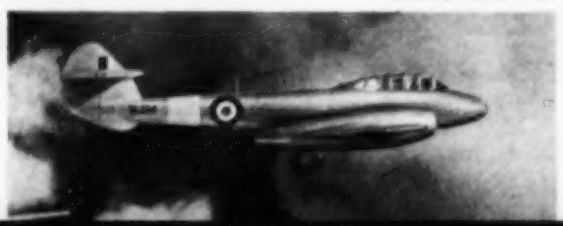
Meteor F.3 (naval conversion).

Meteor 4 (EE455).

Reheat Derwent Meteor.

Avon-Meteor.

(Below) Meteor T.7.



Meteor F.8

Sapphire-Meteor.

P.V. ground-attack Meteor.

Soar-Meteor.

Jet-deflection Nene-Meteor.

MARS TO JAVELIN . . .

first winterization trials at Edmonton, Canada, in 1946. One machine of the type was delivered to each of the air forces of Australia, New Zealand and the Union of South Africa, for experimental and local-test purposes. EE338 and EE416 were used for ejector-seat trials; EE379 was fitted with a nose probe for flight refuelling, and set up a jet endurance record of 12 hr 3 min on August 7th, 1949; and EE445 was fitted with a Griffiths wing by Armstrong Whitworth.

Meteor F.3 (Naval Conversion) Meteor EE337 was fitted with Derwent 5 engines in short nacelles and a deck-arrester hook. The inboard undercarriage doors were removed, and a cable deflector was mounted on the nosewheel leg door. This aircraft was used for special investigations into the problems of carrier-borne jet fighters and was flown from H.M.S. *Implacable* in the Firth of Forth.

Meteor F.4 In external appearance this mark resembled the long-nacelle Mk 3, but had a greatly improved performance by virtue of its Rolls-Royce Derwent 5 turbojets, each of 3,500 lb thrust. The prototype flew in July 1945.

During the autumn of 1945 two Meteor F.4s were taken off the production line and groomed for an attack on the world's air speed record. Military load was removed, the structure was strengthened at local points, and special attention was paid to surface finish. The first machine—EE454—was finished in normal R.A.F. camouflage, was named Britannia, and was flown by G/C. H. J. Wilson. The second, EE455, was painted yellow and was allocated to Gloster test pilot Eric Greenwood. A third Meteor 4 was used as a high-speed practice aircraft and hack. On November 7th, 1945, G/C. Wilson succeeded in breaking the speed record over a 3-km course at Herne Bay, Kent, with a speed of 606 m.p.h. (this being the average of four runs) and Eric Greenwood put up a speed of 603 m.p.h. on the same day.

For the second assault on the record, in 1946, two special Meteor 4s were prepared for the R.A.F.'s High Speed Flight. Known as "Star Meteors," they were numbered EE549 and EE550. Their Derwents were uprated to deliver 4,200 lb thrust, and the Perspex cockpit canopies were replaced by metal hoods having small Perspex inserts, this measure being necessary because the normal canopies tended to deform in flight. On September 7th, 1946, G/C. E. M. Donaldson, in EE549, raised the record to 616 m.p.h.; EE550, flown by S/L. W. A. Waterton, attained 614 m.p.h. The third member of the High Speed Flight was F/L. Neville Duke.

Subsequent to the first record R.A.F. production Meteor F.4s were turned out with wings of reduced span (37ft 2in) in consideration of structural strength and rate of roll. At first the ailerons extended to the extreme wing-tip, but were later inset, with a separate tip section. In this latter form the Meteor F.4 was built in large quantities not only for the R.A.F. but for the Argentine, Holland, Belgium and Denmark. The type was also constructed under licence in the Fokker works at Schiphol.

The standard Meteor 4 weighed 10,050 lb empty and 14,500 lb at full load, the wing loading being 38.7 lb/sq ft. Top speed at sea level was 585 m.p.h. and 550 m.p.h. at 30,000ft. Landing speed was 120 m.p.h., initial rate of climb 7,900 ft/min, and absolute ceiling 54,000ft.

There were numerous special variants of the F.4, the more notable of which are given separate consideration below. Others were: RA435, fitted with afterburners by Rolls-Royce; RA479, with metal hood; EE519, used for Meteor F.8 wing-tank/bomb-pylon tests: and VZ389, with nose refuelling-probe.

Meteor F.4 (Lengthened Nose) With the object of gaining more tankage space, Meteor F.4 RA328 was given a lengthened nose. A supplementary tank holding 95 gallons of fuel was contained in a 30in-long insertion in the fuselage just aft of the cockpit.

Beryl-Meteor In 1945 Meteor 4 No. RA490 was adapted to take two Metropolitan Vickers Beryl axial-flow turbojets, each of 3,950 lb thrust. Later the same aircraft was converted, as afterwards described, to take jet-deflector Nenes.

Avon-Meteor In 1949 Meteor 4 airframe RA491 was fitted with two Rolls-Royce Avon axial-flow turbojets, whereby it achieved an extraordinary rate of climb.

Atar-Meteor Airframe RA491 was fitted with French Atar turbojets by Air Service Training, Ltd.

Meteor P.R.5 An experimental one-off fighter/reconnaissance version of the Mk 4, serial-numbered VT347, and carrying a camera in a special nose.

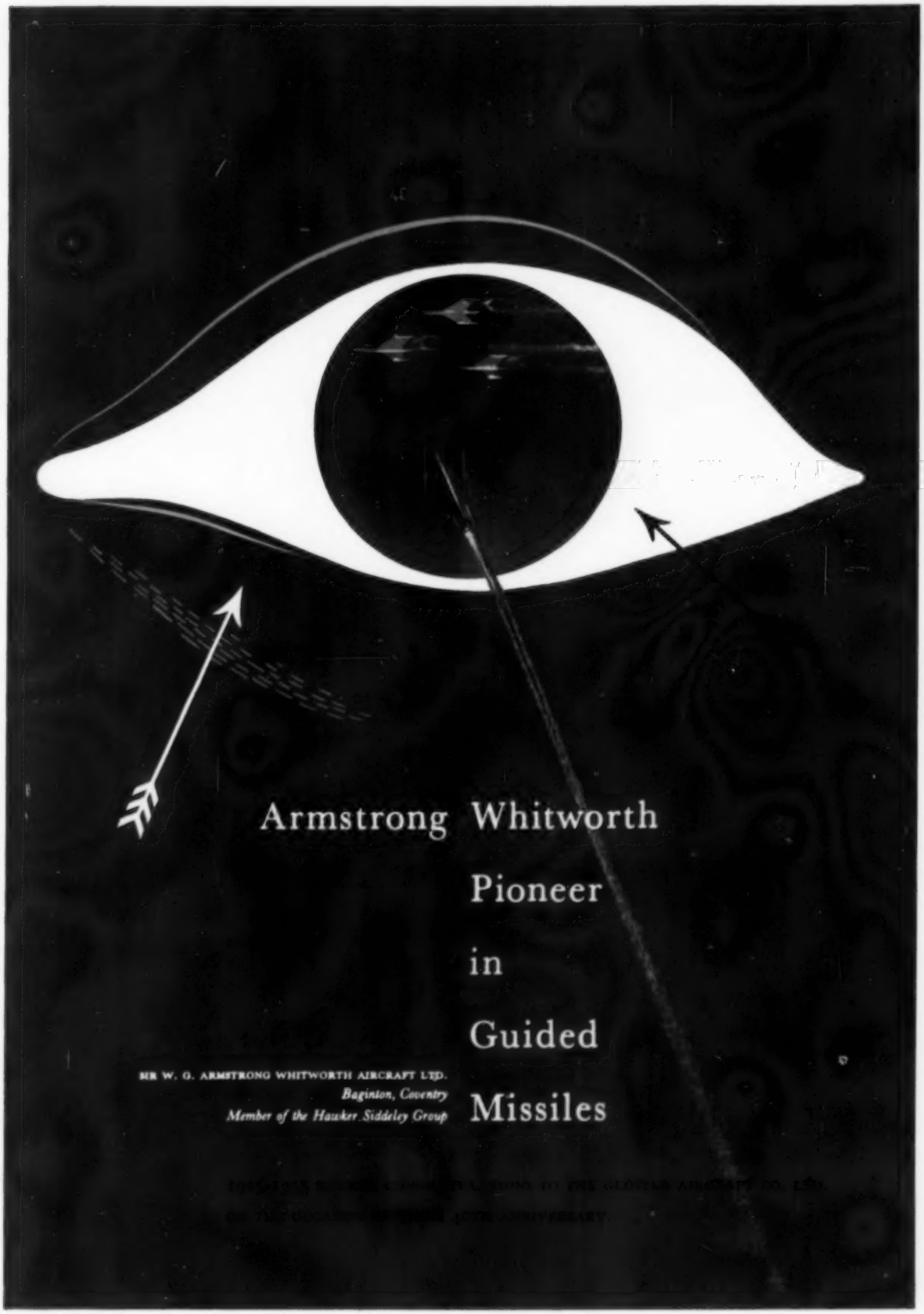
Meteor F.6 A projected version of the Meteor with swept-back wings.

Meteor T.7 With a fighter in the 600 m.p.h. class becoming operational in mounting numbers, a vast training problem began to loom in the R.A.F. and in other Services, and Glosters were emboldened to produce a private-venture dual-control instructional version of the Meteor. Designated T.7, this had a front-fuselage portion lengthened by 30in to permit seating an instructor. No armament was specified. All flying controls were duplicated, and provision was made for carrying a 180-gal ventral drop tank and two 100-gal wing tanks in addition to the normal internal twin-cell 325-gal tank. The power units were standard Derwent 5s.

Being a "P.V.," the first Meteor T.7 had a civil registration —G-AKPK—and was finished in carmine with ivory markings, as was the Meteor F.4 which had toured Belgium and Holland during May 1947. When the present writer was privileged to fly in the prototype during the spring of 1948 he remarked particularly on the tremendous rate of climb of nearly 8,000ft/min. Even the fighter Meteors were unable to hold the new trainer on the climb, though in other respects performance was generally similar.

As now in service the T.7 weighs 10,540 lb empty and 14,140 lb all-up. The Air Ministry specification covering the R.A.F. version was T.1/47. Other countries supplied include the Netherlands, Belgium, Denmark, France, Israel, Egypt and Brazil. Non-standard variants of special interest included EE513 and 530 (Meteor 4 conversions); G-AKPK, incorporating components from the P.V. Meteor 4 G-AIDC, and ultimately delivered to Holland; EE530 and WL375, modified with Mk 8 rear fuselage and Mk 9 camera nose; WE867, with tail parachute; and VW413, aerodynamic test vehicle for N.F.11.

Meteor F.8 The "long-nosed" Meteor F.4 RA382 was the forerunner of a considerably redesigned model designated F.8 and developed primarily to improve the handling characteristics at the higher Mach numbers. Maximum fuel tankage was 795 gallons,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SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.
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1915-1955

1921—THE GLOSTER SEARS, survivor of all Gloster aircraft. The Mars I won the Aerial Derby three times, in 1921, 1922 and 1923. The Mars VI, illustrated above, was fitted with an Armstrong Siddeley 'Jaguar' engine.

1925—GLOSTER GREBE. Developed from the earlier Grouse with the Gloster H.S.8. wing section—the Grebe was the first Gloster single seater fighter to be supplied in quantity to the R.A.F.

1927—GLOSTER GAMECOCK.—Between the years 1926-1931 Gloster Gamecocks were standard equipment for R.A.F. Fighter Squadrons. These aircraft had a top speed of 175 m.p.h. in a dive and were renowned for manoeuvrability.

1934—GLOSTER GAUNTLET. The design of the Gloster Gauntlet was continued in 1930. At this stage Gloster development was concentrated on increasing the performance of single seater fighters.

1936—THE GLOSTER GLADIATOR was the last biplane fighter in the R.A.F. and was outstanding for its style from its in World War II. Those included the Norwegian campaign and the Battle defence of Malta G.C.

1941—GLOSTER WHITTLE E28/39. Gloster again made aeronautical history on May 15th, 1941 with the little E28/39. Powered by one of Whittle's early jet turbines, this aeroplane was the world's first successful turbo-jet aircraft.

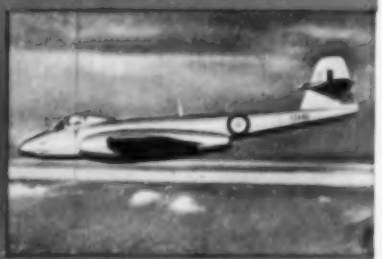
Gloster Aircraft CO., LTD.,

40 Years of Aeronautical Achievement

1928—GLOSTER GORCOCK. The Gloster Gorcock and the later Gloster Goldfinch, were the first metal Gloster aircraft. The Gorcock was a single seater fighter with a Napier Lion engine.

1929—THE GLOSTER VI. Schneider Trophy Seaplane, last of the line of this class of aircraft. Built by the Company for the Schneider Race—it established an official world speed record of 328 m.p.h. on Sept. 10th, 1929.

1948—GLOSTER METEOR 7. A two seater trainer for the instruction of pilots in the handling, navigation and combat procedure of the latest type of jet fighters and bombers.



1950—GLOSTER METEOR 8. The latest fighter version of the Meteor—suitable for high altitude interception, ground attack or close support. The Meteor was the only Allied jet fighter to be operational in World War II.

THE GLOSTER STORY

The nucleus of the Gloucestershire Aircraft Company was formed during the first world war and by 1918 was producing forty-five Bristol fighters a week. The name was changed to "Gloster" in 1924 when the Company moved to Brockworth Aerodrome, near Gloucester. Today the Gloster Aircraft Company Ltd., employs over 7,000 people, has aerodromes at Hucclecote and Moreton Valence, and factory space covering many acres. Gloster aircraft have held the world speed record on four separate occasions; their outstanding quality has led to a steady flow of orders from the Royal Air Force and the leading air forces of the Free World. The latest Gloster achievement is the Gloster Javelin, world's first Delta wing all-weather interceptor. Powered by Twin Armstrong Siddeley Sapphire Turbo-jets the Javelin flies at heights over 50,000 ft and its speed is between 600 to 700 miles an hour Day or night, fair weather or foul, the Javelin is Western Europe's answer to the high level high speed "knock-out" attack.

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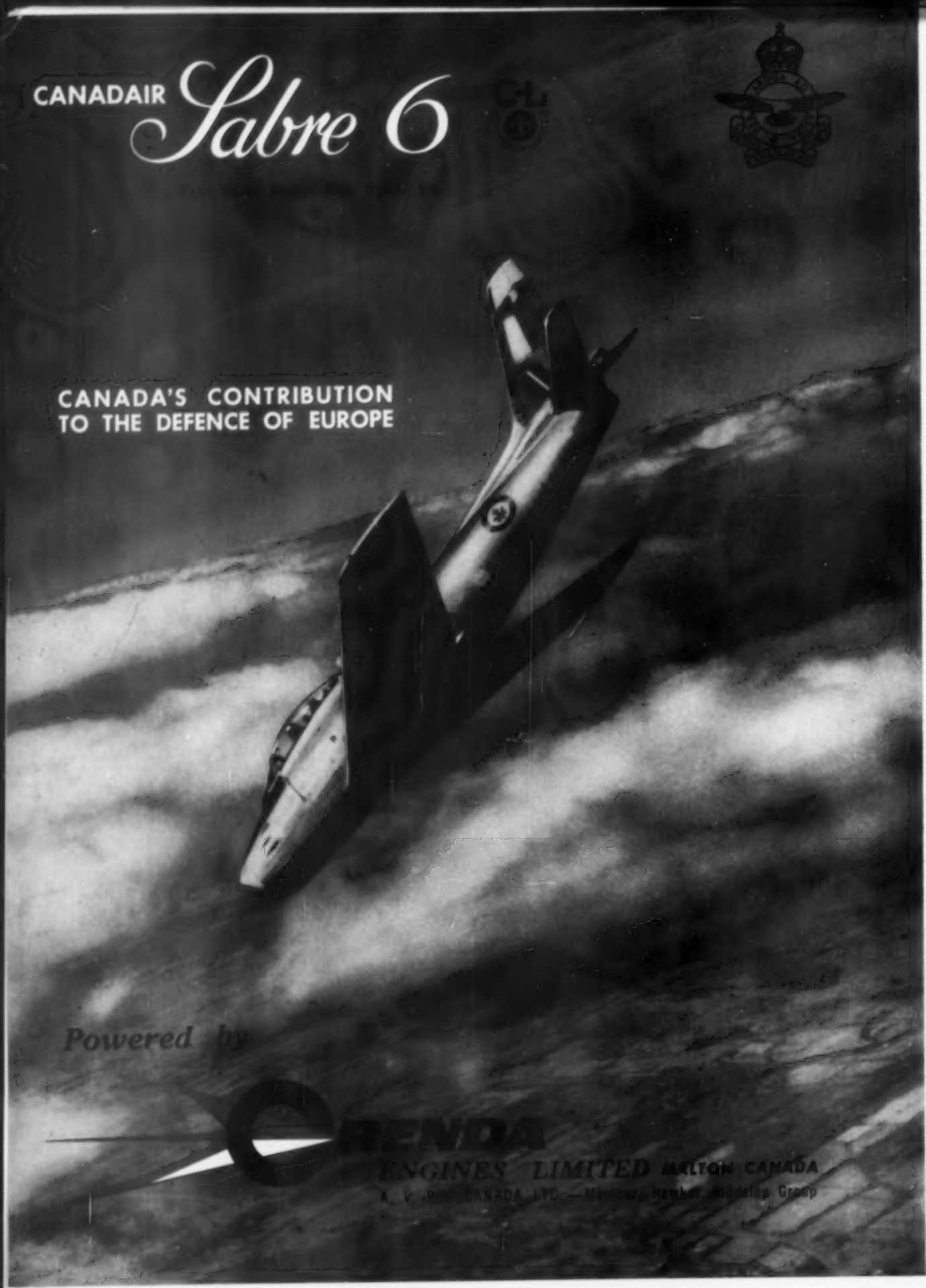
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MARS TO JAVELIN . . .

the main fuselage tanks holding 325 gal, a smaller tank (forward) 95 gal, the ventral tank, 175 gal, and the two wing tanks, 200 gal. Further distinguishing it from the Mk 4 was a completely re-designed tail unit, a lengthened fuselage, revised cockpit enclosure and wing fillets of new design. Elevator and rudder areas were increased and tailplane incidence was reduced from 1 deg to zero. All surfaces were thinner than formerly, the characteristic Meteor fin-cum-skid beneath the tail was deleted, and the fuselage terminated in a cone-shaped fairing. Power units were Derwent 8s. Max. permissible weight has progressively risen to 19,100 lb.

The Meteor 8 was the only British jet aircraft to operate in the Korean war. Forming the equipment of No. 77 Squadron, Royal Australian Air Force, it was used initially for air fighting and latterly for ground attacks with rocket projectiles. Following a visit to the Australian squadron, the writer reported as follows: "The tasks undertaken by 77 Squadron are road reconnaissance, bomber escort, rocket strikes, 'rescap' for downed pilots, stand-bys for attacks on airfield and—in case of large vehicle sightings—'vehicle alerts.' The armed road recces, are flown as required, but usually at first and last light, and the Meteors operate in pairs. Common targets are trucks, locomotives, box-cars, vehicle revetments and supply dumps. Munitions carried are 800 rounds of 20 mm ammunition and two 60 lb R.P.s—the latter for trains or similarly deserving targets. For use against thin-skinned transport the Meteor's 4×20 mm gun armament appears to be as effective as anything. The attacking aircraft fly above the trajectory of light flak and automatic weapons (and below the most effective height of the 'heavies') until the target is sighted. Then they enter a 30 deg dive, weaving to discourage flak until the pilots have to line up on the target and open fire. A full-bore breakaway is indicated, and here the Meteor's excellent rate of climb and unusually quick acceleration are truly appreciated."

The last Meteor 8, number WL191, left Brockworth on April 9th, 1954, flown by Jim Cooksey.

The Meteor 8 passed into large-scale production for the R.A.F., was built under licence by Avions Fairey and Fokker, and was supplied to Australia, Holland, Belgium, Denmark, Egypt, Syria, Israel, Brazil and Ecuador. As in the case of the Meteor 7, late-production machines had large-diameter intakes, spring-tab ailerons and also a clear-view canopy.

Non-standard variants included VZ460, used for R.P. and high-speed-bomb tests; VW360, with eight American HVAR rockets; VZ439, with a special metal cockpit enclosure, having inset Perspex panels, for high-altitude tests; WH320, test machine for braking parachutes. One F.8 was delivered to Canada for afterburning experiments by the National Research Council, and—also flown in Canada—at least one other was fitted with two 30 mm Aden guns.

Sapphire-Meteor Meteor F8 WA820 was adapted during 1948 to take two Armstrong Siddeley Sapphire turbojets, and from Moreton Valence, on August 31st, 1951, established a time-to-height climb record. The pilot was F/L. Tom Prickett, of Armstrong Siddeley. A height of 9,843ft was reached in 1 min 16 sec, 19,685ft in 1 min 50 sec, 29,500ft in 2 min 29 sec, and 39,370ft in 3 min 7 sec. Air Service Training, Ltd., were responsible for the conversion.

P.V. Ground-Attack Meteor Sometimes known as the "GAF" (ground-attack fighter) Meteor, and registered G-AMCJ (later G-7-1), this private-venture development of the Meteor 8 was designed to carry up to twenty-four 96 lb rocket projectiles under the wings and fuselage, or four 1,000 lb bombs. Two 100-gal fuel tanks were carried at the wing-tips. The aircraft was statically shown at the S.B.A.C. Display in September 1950, having been first flown on September 4th by Jim Cooksey. In the twelve months before the following S.B.A.C. Display a great deal of development flying was completed, and it was on this machine that Jan Zurakowski first demonstrated his well-nigh incredible "Zurabatic cartwheel."

Soar-Meteor At the S.B.A.C. Display of 1954 Meteor 8 WA982 was flown with two Rolls-Royce Soar axial-flow turbojets, each of 1,810 lb thrust, at the wing-tips, in addition to the standard Derwent 8s.

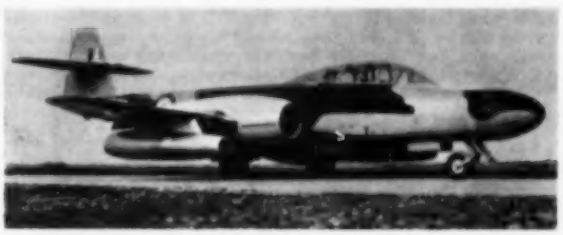
Jet-deflection Nene-Meteor For the purpose of air-testing the principle of jet deflection the airframe of the former Beryl-Meteor RA490 was modified up to Mk 8 standard and fitted with Rolls-Royce Nenes, embodying the special deflection arrangements. The first flight—by S/L. Leo de Vigne, D.S.O., D.F.C., A.F.C., —was on May 15th, 1954. S/L. de Vigne flew the aircraft for over 15 hours at Merryfield and Boscombe Down before it was handed over to the R.A.E. A fully developed jet-deflection installation is considered to offer prospects of shorter ground runs and steeper climb-away, and appears to be especially attractive for Naval applications.

Meteor 7/8.

Meteor F.R.9.

Meteor P.R.10.

A.W. (Gloster) Meteor N.F.11.



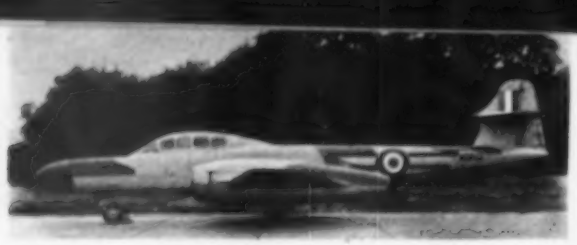
Meteor N.F.11 with SFECMAS ramjets.

Meteor 7/8 This is the P.V. ground-attack Meteor with a Meteor 7 front fuselage. One example is re-registered G-ANSO, and used by Gloster Aircraft as a high-speed communications and demonstration machine. It has a particularly beautiful larkspur blue and ivory finish.

Meteor F.R.9 The F.R.9 was developed for fighter/reconnaissance duties and the prototype, VW360, was first flown on March 23rd, 1950. The airframe resembles that of the F.8, even to the extent of retaining the four 20 mm guns, but in the nose there is a universal-mounting rack, by means of which a camera can be directed to port, to starboard or ahead. The camera is actuated by means of a positive-action switch near the power lever. Sea-level speed of the F.R.9 is 585 m.p.h., initial rate of climb 6,950 ft/min, and maximum range—with three drop tanks—of the order of 950 miles.

Meteor P.R.10 The P.R.10, the prototype of which (VS968) was first flown on March 29th, 1950, is for unarmed high-altitude photographic reconnaissance. Fitted with wings of the original (43ft) span, this variant has a single camera in the nose, as on the F.R.9, and one or two additional cameras farther aft in the fuselage. Extreme range is 1,200 miles and top speed at 30,000ft 542 m.p.h. No armament is fitted.

Meteor N.F.11 Gloster Aircraft being preoccupied with production of Meteor 7s, 8s, 9s and 10s, and with the development of the Javelin, it was decided to farm out all work on the N.F.11—the first of the two-seat night-fighter Meteors—to Sir W. G. Armstrong Whitworth Aircraft, Ltd., another member of the



A.W. (Gloster) Meteor N.F.12.

A.W. (Gloster) Meteor N.F.14.

Armstrong Whitworth Prone Pilot Meteor.

MARS TO JAVELIN . . .

Hawker Siddeley Group. The first prototype, WA546, was flown by S/L. E. G. Franklin, D.F.C., A.F.C., on May 31st, 1950. It was, in effect, a completely new aircraft, though many of its major components were similar to, or even interchangeable with, those of other Meteors. The wing resembled that of the P.R.10, having a span of 43ft, but in the outer panels were mounted four electrically fired 20 mm guns, which had been displaced from the forward fuselage by the A.I. radar. The fuselage was essentially that of the T.7, with the pilot and navigator in tandem under a massive canopy, hinged to starboard, and the tail was that of the F.8. At one time a prototype appeared with wing-tip tanks, but these never became standard. In service the internal fuel is generally supplemented by the standard ventral and under-wing tanks. Meteor 11s have been supplied not only to the R.A.F. but to NATO, for service in France, Belgium and Denmark. Machine number WM232 is employed by the de Havilland company for guided-missile tests.

Meteor with Ramjets A Meteor N.F.11 was converted during 1954 by the Société Française d'Etudes et de Constructions de Matériels Aéronautiques Spéciaux to take two SFECMAS S.600 ramjet units (one under each wing) in addition to its two Derwent 8s.

Meteor N.F.13 This variant antedated the N.F.12, having first been flown on December 21st, 1952, by F/L. J. O. Lancaster. It resembles the N.F.11 but is equipped for service overseas.

Meteor N.F.12 First flown on April 21st, 1953, the N.F.12 has a longer, more streamlined nose of greater internal capacity than earlier N.F. variants, and is presumed to carry more powerful combat radar. Another obvious modification is the fairing in of the tail "acorn" to improve airflow and help to balance the side area of the nose. Overall length is increased to 49ft 11in.

Meteor N.F.14 The first prototype of this improved Mk 12 was flown on October 23rd, 1953, by F/L. W. H. Else. Instead of the old-type massive-framed canopy it has a two-piece blown hood, which, when assembled, has all the characteristics of a frameless structure. The windscreen is also revised. The N.F.14 has been officially described as "the fastest version of the Meteor yet produced," and is extensively used by squadrons of the R.A.F.

Prone-pilot Meteor To investigate the possibilities and problems of a prone-piloting position for high-speed aircraft, Armstrong Whitworth, during 1954, fitted a Meteor N.F.14 (WK935) with a prone position in the extreme nose. The normal pilot's position (the aircraft carries two) has a Meteor 8 canopy.

THE E.1/44s

E.1/44 Unofficially called the Ace, the Gloster fighter conforming to Specification E.1/44 was a mid-wing monoplane, with a single Rolls-Royce Nene 2 engine of 5,000 lb thrust. The lateral intakes gave it a notable breadth of fuselage, and the wing had a pronounced taper. There was a single main spar, with stainless steel booms, and an auxiliary rear spar. In addition to the ordinary flaps and air brakes, dive-recovery flaps were embodied. Internal provision was made for 428 gallons of fuel, and two pylon-mounted tanks could be carried under wings. The armament of four 20 mm British-Hispano guns was grouped in the nose.

The first prototype—SM809—was completed in July 1947, but the low-loader which was transporting it to Boscombe Down met with an accident while descending a hill, and the aircraft was badly damaged, thereby delaying the development programme. Building of the second prototype, TX145, was thereupon expedited, and this machine took the air, with S/L. Waterton as pilot, on March 9th, 1948. All-round performance was not greatly superior to that of the Meteor 4 and no production order was forthcoming. The third prototype, TX148, had a high-set tailplane on a square-cut fin-and-rudder assembly and is reported to have been a vastly improved aeroplane on that account. It was eventually handed over to the R.A.F. for development test work on flying controls and braking parachutes.

ENTER THE JAVELIN

Javelin FAW.1 (G.A.5) Specification F.4/48 called for a night and all-weather fighter of very high performance, yet having a long endurance and carrying very heavy armament and the most comprehensive electronic aids. Design projects were submitted by Gloster (G.A.5) and de Havilland (D.H.110), the former being a large delta-wing aircraft with a T-shaped tail unit, and powered with two Armstrong Siddeley Sapphires of early make.

The first prototype, WD804, was built at one of Gloster's wartime dispersal factories and was transported by road to Moreton Valence airfield, where it was reassembled and put through its taxying tests by S/L. Waterton. On November 26th, 1951, Waterton took it into the air for the first time, remaining airborne for 34 minutes. Development flying continued until June 29th, 1952, on which day the elevators came adrift. The subsequent crash-landing—which won Waterton the G.M.—had little effect on development, for only a few weeks elapsed before the second prototype, WD808, powered by later Sapphires, of 8,200 lb thrust each, was in the air. During July 1952 the Air Ministry decided to order the G.A.5 in quantity, conferring upon it the name Javelin. The first production machine, XA544, was in the air on July 22nd, 1954, and together with the third, flew in company with three of the prototypes at the S.B.A.C. Display of that year. It had been made known in the preceding month that, in the dive, the aircraft "had been exceeding the speed of sound for some time."

The Javelin's wing is of 52ft span and some 900 sq ft in area; thus, although the gross weight may exceed 30,000 lb, wing loading remains low. Originally straight, the leading edge is now slightly "kinked" (this feature was first introduced on the second prototype) thereby increasing the chord of the outer portions. The wing contains the built-in armament of four 30 mm Aden guns, and carries flaps—the use of which is made possible by the fitting of a tailplane—and perforated air brakes. The fuselage is flanked by the long housings for the two Sapphires, and is 57ft in length. Pilot and radar operator have tandem ejector seats under a lengthy canopy, and the nose is given over entirely to a massive radar installation, now of almost pointed form though at one time blunt. Internal fuel tankage is great, but the Javelin can carry in addition two auxiliary tanks, attached beneath the engines. Production Javelins will eventually be armed with guided missiles, in addition to their guns, and it is known that the type is capable of fighting (not merely flying) at heights of over 50,000ft. Take-off and landing qualities and rate of climb

E.1/44 (second machine).

Congratulations to Gloster Aircraft

40TH ANNIVERSARY

The Gloster Javelin all-weather fighter is powered by two Armstrong Siddeley Motors Sapphire turbojets built at Gloucester in a newly equipped and modern factory by the Brockworth Engineering Co. Ltd.

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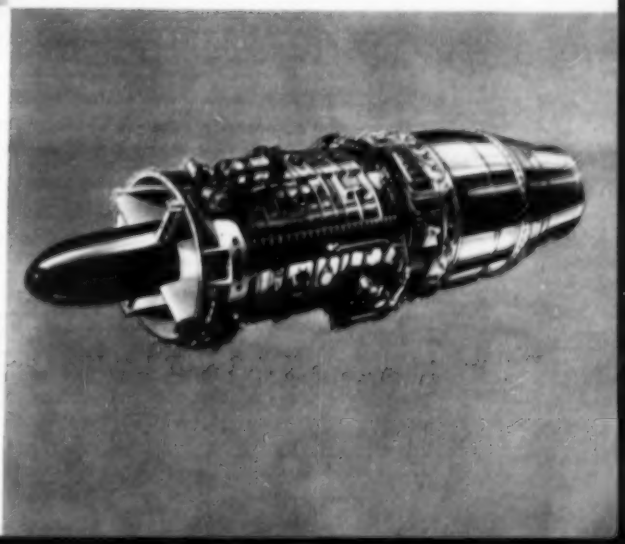

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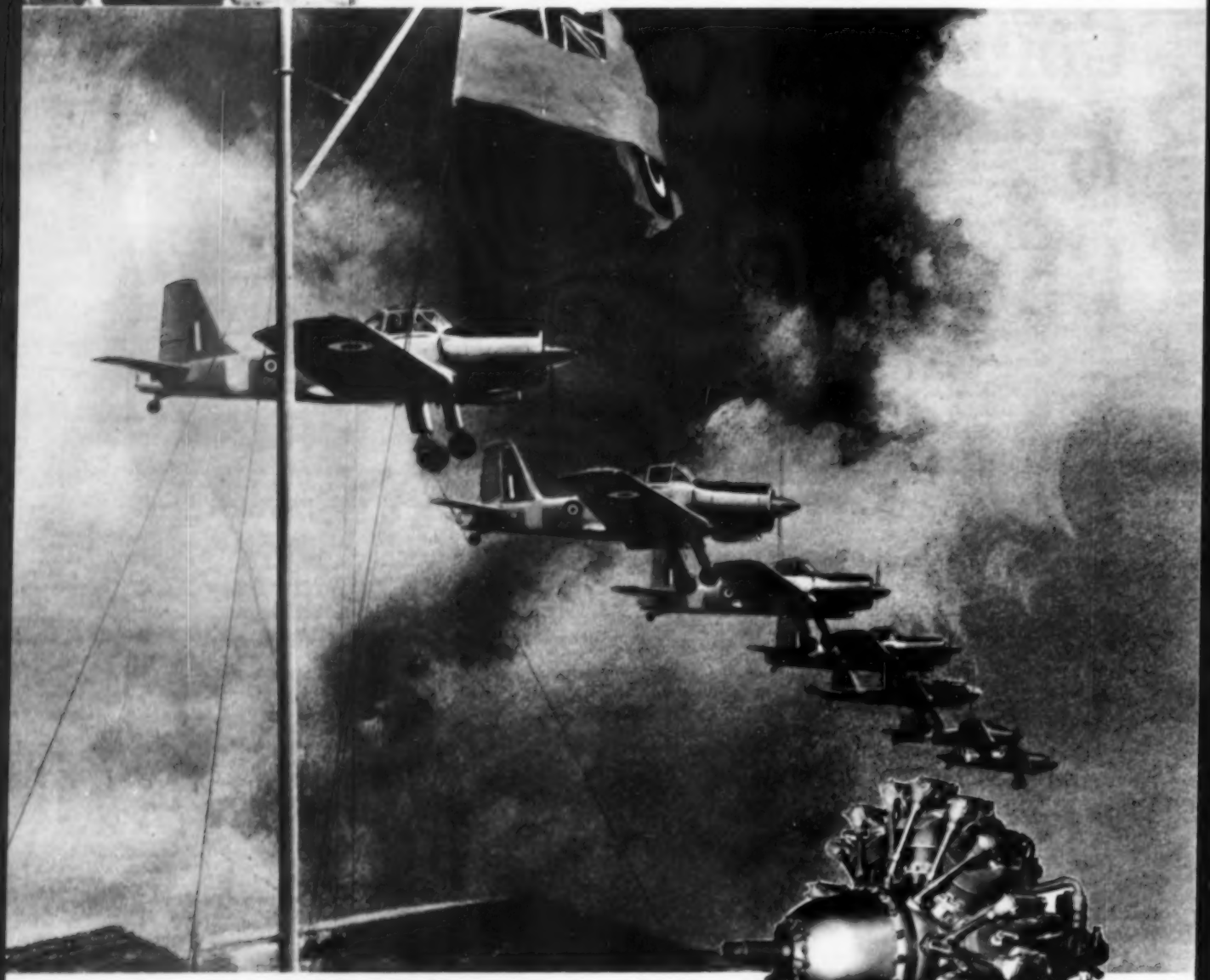

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MARS TO JAVELIN . . .

and manœuvrability are of an exceptional order for a machine of the class.

Though it has met with its full share of teething troubles and has cost the lives of two test pilots, the Javelin, as shortly to be delivered in numbers to the R.A.F., stands now as an achievement of exceptional merit and one which will endow the Service with defensive powers of a matchless order.

Javelin Development It was officially announced in March this year that a new all-weather fighter is being developed from the Javelin, and it has been reported in the American Press that this will be powered by Bristol Olympus turbojets.

Javelin FAW.1 (first prototype).

(Right) Javelin FAW.1 (fourth prototype).
(Below) Javelin FAW.1 (first production machine).

Photographed at Gloster's Moreton Valence airfield last September with an early-production Javelin FAW.1 are, left to right: E. S. Greenwood (Gloster publicity manager); R. W. Walker (technical director); Col. A. L. Haley (U.S. Assistant Air Attaché); Col Tucker, U.S.A.F.; W. Downing (production manager); Brig. Gen. H. S. Jones; Brig. Gen. J. J. O'Hara; Maj.-Gen. J. Spry, U.S.A.F.; H. Burroughes (director); P. G. Crabbe (managing director); Hon. Roger Lewis (Assistant Secretary of the U.S.A.F. (Materiel)); Lt.-Gen. D. L. Putt, U.S.A.F.; E. W. Shambrook (director and company secretary); D. Lovelock (M.o.S.); R. F. G. Carse (sales manager); Col. D. W. Graham, U.S.A.F.; and A. Cdre. Silyn Roberts, director of R.A.F. aircraft research and development, M.o.S.

PART III: FRIENDS IN THE GLOSTER FAMILY

A. Cdre. A. H. Wheeler's Memories of Grebe, Gladiator and E.28/39

PILOTS who have flown a considerable variety of Service aircraft over the last 30 years or so may endorse my recollection of the Gloster Gladiator as the most perfect aerobatic aeroplane of them all. To this thought one may add another, though without in any way detracting from the Gloster designer's achievement: namely, that anyone who built an aeroplane at that time to that specification had an opportunity which did not exist before and, probably, will never exist again.

Before the Gladiator was built, engine power had always been just a little too low to give the aerobatic pilot that small reserve which would enable him to perform any manœuvre of the loop-and-roll family while yet remaining confident of not losing height; with the Gladiator he could be sure of gaining it throughout his performance. After the Gladiator, engine power did indeed increase enormously, but the result was that cantilever monoplane construction became inevitable, and wing loading was also increased. I think most people will agree that the monoplane with high wing loading never gave one the same confidence in aerobatics as did the lightly loaded biplane.

There must have been other aircraft which were contemporaries of the Gladiator and which had the same characteristics; but personally, I never flew one. One is, of course, inclined to be biased towards any aircraft on which one has done a lot of flying, and this may apply to the Gladiator in my own case. One happened to come my way in 1943 when I was at Farnborough and by devious means I managed to retain it all through 1944 when I had an Airborne Forces station and the alternative to flying a Gladiator was a Stirling or a Tiger Moth. The Stirling was for the serious business of Airborne operations of all kinds—and a very fine craft it was for that purpose; the Tiger was all the Air Force could spare as a communication aircraft for station commanders. It was a most attractive little aeroplane to fly, but cold and draughty, and it certainly did not have the reserve of engine power of the Gladiator. It is possible, therefore, that this period prejudiced me in favour of the last of the high-powered biplanes.

Another feature of the Gladiator—and one which may largely have been a virtue of the times—was that it was extremely easy to loop or roll. The very early aeroplanes of the twenties always seemed to me to need a certain amount of care and skill when one wanted to do an aerobatic involving the use of a lot of aileron, whereas a loop was easy. As engine power and wing loading increased the loop seemed to need much more care, but a roll or any manœuvre by aileron was very easy indeed. The Gladiator was fortunate in coming at that particular design-period when it was possible to make both manœuvres easy on the same aeroplane.

If the Gladiator could be criticized at all, one might say that, flying it, one was perhaps conscious of beginning to lose that sense of being actually part of the machine. Fighters had by then started to get big. In the Gloster range one had to go back as far as the Grebe to find that sense of being part of the aeroplane—the feeling that one could lean to one side and tilt it like a bicycle.

But, if my memory is correct, the Grebe had only 365 h.p. Though I had had only one flight in one—a met. climb to 20,000ft—I well recall that lack of reserve of power as we approached the top of the climb, and more particularly because it was beginning to get dark on earth below. At that time the pilot certainly felt very much one with the aeroplane—and very much alone. But the Grebe was a delightful little aircraft to handle and even in the growing dusk on a first flight it gave one a sense of confidence

The author (right), with W/C. "Dickie" Martin, Gloster's present chief test pilot, and a surviving Gladiator.

MARS TO JAVELIN, PART III. . .

(which, incidentally, the man who lent me the Grebe did not feel, for he started to get out a flare-path to help the landing, but only succeeded in making it infinitely more difficult).

Grebe and Gladiator were the only two early Glosters I had the good fortune to fly. But since I have been asked to give my impressions of those members of the family I have known I should add the Gloster Whittle (or, as we first knew it, the E.28/39) and the Meteor, although the latter is so well known today that there is nothing much to say about it.

I first flew the E.28/39 at Farnborough on January 3rd, 1942, but before giving my own impressions on that interesting, attractive and unique aircraft I must record those of someone much better qualified to comment on it, namely G/C. "Willie" Wilson, at that time the Chief Test Pilot at the Royal Aircraft Establishment. He was the first pilot to fly it when it arrived at Farnborough, and I met him as he climbed out of the cockpit; what, I asked him, were his impressions? He thought for some time before replying; then he said, "Well, it's the first aeroplane I've ever flown where you can actually see the fuel gauge moving whilst you fly!"

And, indeed, the extremely limited endurance of the E.28/39 did seem to colour everything one did on it. The lack of endurance is no implied criticism of the design. The E.28/39 was required as an airframe in which the Whittle engine could be test flown, and it did the job exceptionally well. Everyone concerned with it knew that the then new jet engine used up fuel much faster than a piston engine and that the endurance would therefore be low; but it was just enough to do the tests required.

I think I am correct in saying that in none of the tests I personally made with it did I have enough fuel left, as I came in to land, to allow for going round again safely. Under such conditions one takes a very great deal of trouble in judging one's approach. Fortunately, the aircraft was of the tricycle type and thus very easy to land, and Farnborough runway was a very long one even then. I well remember one of my pilots who just did not have enough fuel to land. He had been told to do level speeds at low altitude—and, as everyone who has anything to do with jets knows, that is about as good a way of burning up paraffin as has yet been invented. This particular pilot got through all he had in three long levels, but luckily he was going towards Farnborough when his engine cut. He was also going very fast, so he merely pulled the stick back and went up to five or six thousand feet, where he had time to sort himself out and prepare for a power-off landing—which, all praise to him, he achieved successfully. At that time it would have been a very serious thing indeed if that prototype had been damaged.

My own first flight consisted of doing level speeds, i.e., recording the maximum speed attainable in level flight at 25,000ft and at 5,000ft. Engine hours on the Whittle unit were so precious then that we did not normally allow any flight time for familiarization; and, in any case, it was the engine, not the airframe, on which we were collecting data. The result was that one gained one's impressions of the E.28/39 bit by bit in different flights.

The first impression one received—not counting that fuel-gauge movement!—was of the wonderful smoothness, quietness and lack of vibration of the jet engine. Such a characteristic was then new to all of us, and it made a memorable impact. The actual handling of the aircraft was perfectly straightforward. I recollect that one of the pieces of information the scientific staff seemed to be keenest about was engine temperatures as one was climbing and diving through certain specified altitudes. We had few recording instruments and it was extremely difficult to achieve an exact speed at an exact height as one dived through it with a predetermined throttle setting.

I well remember being most carefully briefed on exactly what was wanted on this type of test. My knee-pad was covered in figures and I was just going to start the engine when someone came rushing out of the flight office to tell me that permission had just been received from the Ministry of Aircraft Production to do aerobatics on the E. 28 in order to see how the engine functioned under such conditions. Would I like to try some instead of "dives and climbs through 20,000ft"? Would I! Very thankfully I handed over my knee-pad with all the figures on it and prepared for a much more interesting and exhilarating flight. However, it was not to be quite so easy as I had expected, for a further briefing was necessary to ensure that I did not subject the engine to more than 2½ g, and no negative was allowed at all.

On the whole the limitations were very simple to comply with, particularly in a roll; so long as one "barrelled" the roll appreciably there was no chance of putting on any negative g. I wasn't so happy about the loop since, as I mentioned earlier, a loop with modern aircraft needs a certain amount of care; and when one must not exceed 2½ g it needs more care. As it was, I determined to keep well within 2 g for safety. I accordingly went into the loop very fast and pulled the aircraft round slowly with, I thought, plenty of speed in hand. At the top of the loop there was a bit of a bang and the whole machine shook; but it came on round.

When I was straight and level again I became aware with some consternation that the engine was not giving any power. I looked hurriedly at the jet-pipe temperature, which at least reassured me that the fire hadn't gone out. I then glanced at the instrument—not fitted on modern jets—recording "burner pressure." It recorded about 37 lb/sq in, which was on the low side and rather puzzled me until I remembered that it was controlled by the throttle. We had been most carefully briefed not to let the burner pressure go below 40 lb/sq in except at low speed, for fear of the fire going out. Then it dawned on me what I had done. In the excitement of the bang and shudder at the top of the loop I had instinctively closed the throttle without realizing it. When I opened it again all was well. I seemed to have proved also that the fire didn't necessarily go out if you shut the throttle suddenly at high speed. On consideration I think I probably pulled the aircraft over the top a little too fast and got the beginning of a stall, although the g applied at the top cannot have been more than about 1½ at the most.

Taken all round, the E. 28 did its aerobatics very well, though, as I have said, we did not have much opportunity to try out the handling qualities.

One of the most difficult things about the E. 28 was starting up the engine. A large number of actions had to be performed in exact sequence and at the right time. The procedure was to count seconds to oneself. It started something like this: "Turn on H.P. cock . . . two . . . three . . . press initial starter button . . . four . . . five . . . six . . . seven . . . press secondary starter button . . . eight . . . nine . . ." I seem to remember one got up to about 17, by which time either the engine was running nicely or a lot of people were waving their arms and shouting at one. In fairness to the Whittle engine, one must say that failure to start properly was always due to mishandling of the starting system. Later, of course, a sequence timer was produced which has made jet starting easy—in fact, taken all the fun out of it.

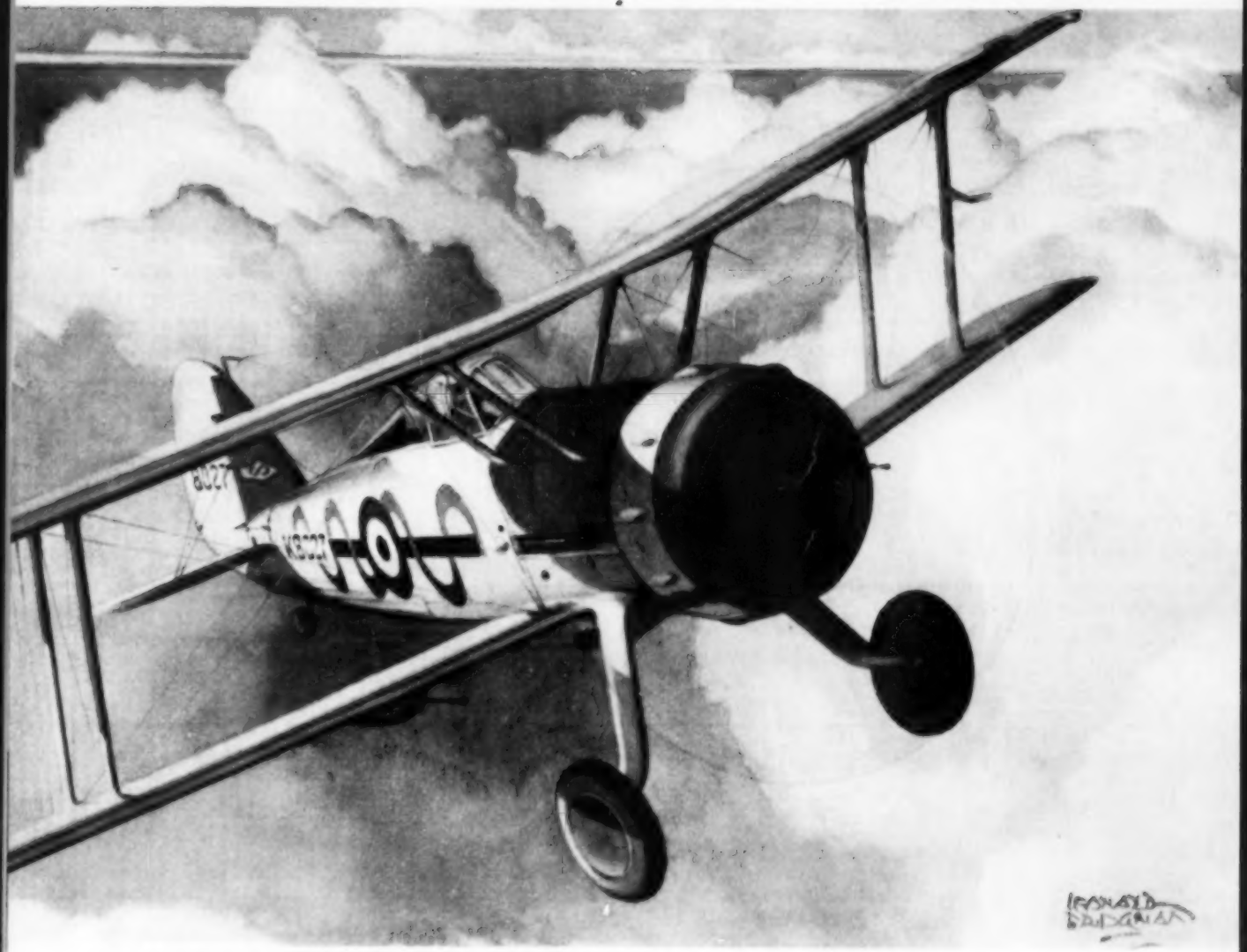
I don't think there is much more to add about the E. 28/39, although it might not be out of place to record here the story of S/L. Davie's dog, since it illustrates how new the idea of a jet efflux was to all of us. I had put Davie in charge of the jet flight because, apart from being a brilliant and enthusiastic pilot, he also had a university degree which could help him to understand the intricacies of the subject. (He was, unfortunately, killed later in a prototype Meteor fitted with a new type engine on test.)

At the R.A.E., Davie's dog, a black spaniel, always used to see his master off when he went to fly, and meet him again when he returned. On the first occasion on which Davie flew the E. 28 the spaniel faithfully came out to see the aircraft start—then sauntered off, passing behind the jet just as the engine was being opened up. He was facing "down-jet" and about ten yards behind the tail-pipe. He became aware of the stream of air and decided to hold his ground, standing still with all four legs planted firmly out in front. First his hair all blew forward, then his large black ears stuck straight out down-wind; and finally his grip on the ground failed and he bowled over and over until he came to rest, a sad but much wiser dog, in some bushes twenty yards away.

One may laugh, but the dog was by no means the only one who made such a mistake; even very senior officers of the Royal Air Force sometimes did likewise.

The Meteor is so well known that I can add very little about it. It was certainly the first aircraft to bring home to us how comfortably and safely one could travel about the world at an *average* speed approaching half the speed of sound. I mention safety intentionally, because it does seem to incorporate all the essential ingredients for safe flying. It can carry enough fuel to have an adequate reserve for all ordinary requirements. It has two engines: if one is unlucky enough to lose one the worst is that one must finish one's journey at an average speed of some 300 m.p.h.! The Meteor gives a very great deal of warning before it either stalls or gets into compressibility trouble. Its landing characteristics are good and its brakes excellent. I know at least one retired air commodore who would be very happy to use a Meteor as a personal hack in his declining years. . . .

AS IT WAS . . .



THE GLOSTER GLADIATOR, last of a noble line of biplane fighters fought its last action over the George Cross Island and passed into history — and the Gloster company designed the forerunner of a new and revolutionary generation of fighter aircraft, the Gloster-Whittle E.28/39. But before the E.28/39 had flown Glosters received their first production order for the famous twin-jet Meteor fighter. Today the Meteor gives place to the Javelin, the world's first all-weather delta-wing fighter.

Still the pace quickens, and every new project brings fresh problems. Questions about fuels and lubricants to meet these increasingly exacting conditions are the constant concern of ESSO research groups whose information and advice are freely at the disposal of enquirers with problems in this field.

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J71

Allison's Big Axial Turbojet

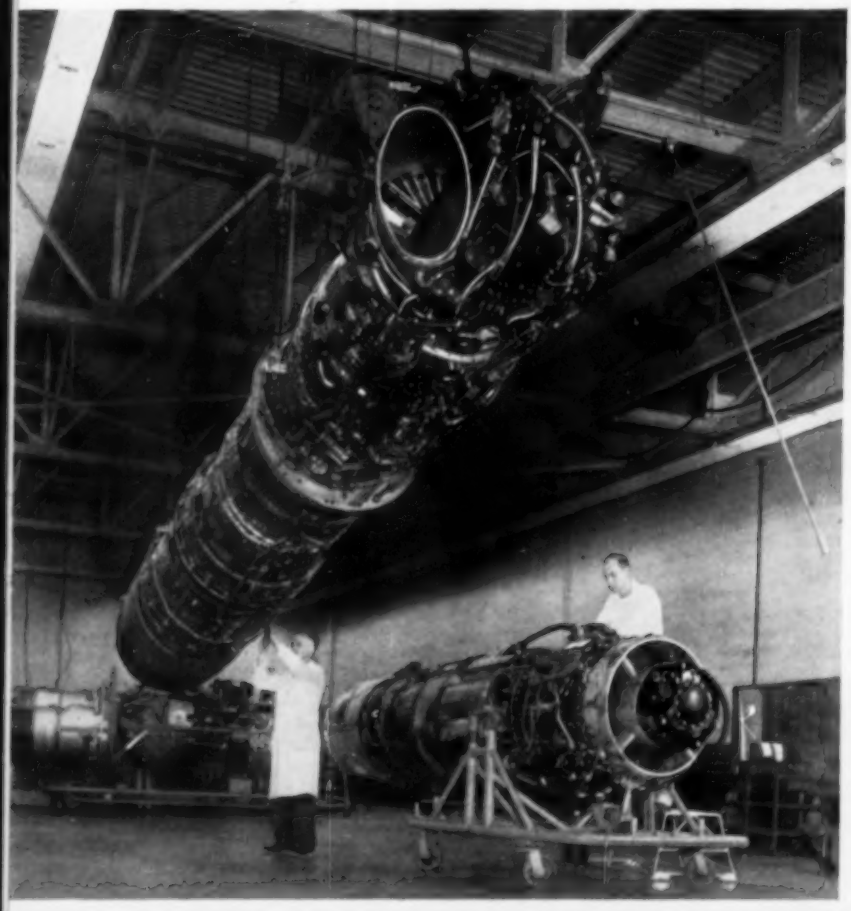
ALTHOUGH the ground-work of American jet development was largely laid by G.E.C., the first large American axial design, the TG-180, was passed to the Allison Division of General Motors who were better placed to undertake large-scale production. Previously Allison had been noted for their range of 1,710cu in V-12 piston engines.

As the J35, the basic TG-180 has now been made by Allison in enormous numbers. During the past ten years, the company have also developed a family of turboprops which are beginning to reach military service and have also tackled the problem of developing a large turbojet to succeed the J35 on the production lines. This new turbojet is the Allison J71, the fact that it has an odd number indicating that the initial design was sponsored by the U.S. Air Force and not the Navy.

The basic design of the J71 was virtually complete by 1950 and early examples of the engine were run in that year. Since then, considerable development has taken place, and present engines have the following features. The compressor has 16 stages, all mounted on the same shaft as the three-stage turbine. The combustion system is of the cannular type, consisting of a two-piece stainless-steel chamber housing ten interconnected flame tubes. Concurrently with the basic engine has been evolved an exceptional variety of auxiliary devices, including a variable-area tailpipe, an electro-mechanical control system, automatic intake screens to prevent the ingress of ice and foreign material, an integral oil and hydraulic system, and a comprehensive range of engine and airframe accessories including a power-pack driven by an air-turbine motor. The J71 is also available with at least two types of afterburner, both of which are completely cleared for service. One afterburner is employed for take-off and low-altitude boosting and another is specifically for increasing the performance of fighters at high altitudes.

The principal bone of contention in the J71 design is that it is a single-shaft engine. According to Allison, the design was specifically intended to meet the need for "a single-compressor engine with high compression ratio which would match good fuel economy with maximum thrust"; Mr. E. B. Newill, general manager of the Allison Division and vice president of General Motors, recently stated that the J71 had "demonstrated thrust in excess of 10,000 lb with the highest pressure ratio of a single-compressor engine yet developed. In addition, this engine develops more thrust per square foot of frontal area than any jet engine ever produced." (The last sentence is incorrect, if Mr. Newill's statement is based on his company's published figures; the later Sapphire and Olympus can both achieve better thrust per unit frontal area, even on type-tested ratings.) The diameter is 39.5in, and the basic engine (without afterburner) weighs about 4,100 lb and is 191.4in long. Several 150-hr tests have been run at 10,000 lb at 6,100 r.p.m., with an s.f.c. of just under 0.9lb/hr/lb.

The mass-flow and pressure-ratio are, respectively, of the order of 172 lb/sec and 8.75:1, figures which are well up to the best values achieved by other type-tested turbojets. The establishment of a single-shaft pressure-ratio of this order (in an engine used by such aircraft as all-weather carrier-based fighters) is a remarkable achievement. After a lengthy incubation, Allison now seemed pleased with the engine and would, no doubt, strongly deny regret at the acceptance of such a layout.



The illustrations show two representative types of engines at present in production at Indianapolis. The larger picture shows the J71-A-2, which is installed in the McDonnell F3H-2N Demon, a transonic carrier-based all-weather machine. A point of interest (apart from the engine's immense size and complexity) is the jungle of accessories between the bifurcated intake ducts. The −2 engine has the long type of afterburner, which raises the thrust to 15,000 lb. Without afterburning the J71 gives 44 per cent more thrust than the earlier J35, also seen in the large photograph, which is of roughly the same diameter.

The smaller photograph shows the J71-A-11 for the Douglas B-66 and RB-66 tactical and reconnaissance bombers. This engine is considerably shorter than the other, principally owing to the fact that it has no afterburner. It picks up at four points inside a single nacelle, one such power-installation being pod-mounted under each wing of the Douglas bomber. Accessories in this engine are spread around the lower half of the compressor; the starter is an air-turbine motor, which draws compressed air from a Solar gas-turbine/compressor trolley. In the photograph the nose-drive pad is not yet occupied and the intake fairing has not yet been fitted, in order to reduce the overall length for shipment. The retracted intake screens are visible.

One type of J71 with the short afterburner is fitted to the Martin XP6M SeaMaster. These engines, designated J71-A-4, are mounted above the wing in two paired nacelles, the afterburners projecting behind the trailing-edge. Full afterburning thrust is employed in this aircraft for take-off and also to increase the performance at low altitudes during mine-laying or photographic missions.

JET-AIRLINER SYSTEMS

ELECTRICS, HYDRAULICS, AIR CONDITIONING, PRESSURIZATION AND FUEL SUPPLY

THE safety and comfort of the passengers and crew of a jet airliner depend to a very large extent on the functioning of the aircraft's systems; in fact, such services as pressurization, air conditioning and hydraulic power for flying controls become as necessary as the wings themselves. Yet such systems are still comparatively new in conception and there has yet been little opportunity of describing them in operation since the latest air conditioning and powered control equipment has mostly been applied to secret military aircraft. The emergence of the S.E.210 Caravelle, not restricted by security regulations, except for its engines, provides an excellent example of the way in which these new services are incorporated in a large jet aircraft. The description might well apply to the Comet and similar projects since a proportion of the components, particularly in the hydraulics, are directly based on de Havilland experience, as well as on S.E.'s own projects in the past, of which the Grognard was one.

Taking into account the whole sequence of a commercial flight, it is difficult to attribute major importance to any one system, but since so much of the detail controls and valves are electrically operated, the electrical supply may appropriately be dealt with first. This is followed by the hydraulics—which might be termed critical, since the flight controls depend entirely upon them. Air conditioning and pressurization are hardly less significant, however, and the importance of fuel supply is obvious. Upon these systems, as much as upon the aircraft's structural integrity, does the overall efficiency and safety of the jet airliner depend.

Though the Caravelle is a French product, many British firms have a part in it, particularly de Havillands and Rolls-Royce, and Lockheed, Dunlop, H. M. Hobson, Venner, Teddington Controls, Self-Priming Pumps, Flight Refuelling and Graviner, to mention only those here directly concerned. Aero Research, Ltd., are, of course, responsible for Araldite used in the spot-welded and glued stringer/skin structures.

The electrical system of the Caravelle has been designed for maximum reliability and also for the greatest possible degree of safety should any failure occur; and, like the other systems to be described, it is intended for automatic operation, though having full facilities for direct control.

There are two engine-driven generators, two main converters and one stand-by, two sets of batteries, and a ground-supply connection. Because the Caravelle is designed to start its engines with power from its internal batteries, the main block of these can be switched either in series for engine starting or in parallel for emergency use. This large block is therefore called the stand-by battery, and a smaller block the aircraft battery. The whole electrical supply is set up in the three sections, shown in the diagram, which normally operate together but which, in case of failure, are cut out one after the other.

The generators are Bendix 30E029C type, supplying 30 v and 375 amp D.C., with a peak power, limited to 30 min, of 400 amp. The aircraft battery is an American André Yardley 40 amp hr, 24 v, silver-zinc battery with 15 cells, weighing 11 kg (24 lb) and made under licence by Andyar in France. The stand-by block consists of five of these batteries, which, when connected in series for engine starting, supply 112 v D.C. Total weight of this block is only 53 kg (116 lb). The English licensee for these batteries is Venner Accumulators, Ltd.

The main converters, mounted together with the main generators, are Bendix 1518/1, rated at 115 v, 400 cycles A.C., 2,000 va, and only one at a time is used. The emergency converter is 80 va, and is switched on automatically should the main supply fail. It is run from the aircraft battery.

A further supply, transformed to 26 v A.C., is taken from the normal 115 v supply to work the position-indicating synchros. It can be seen that a great number of solenoid-operated valves are included in the Caravelle's various systems and in almost all cases where direct control from the cockpit is mentioned in subsequent descriptions, it is performed by this means.

The accompanying diagram shows how the three distribution systems are linked with batteries and generators. The whole is so arranged that, should one generator fail, unneeded circuits and the battery charge are cut out. If the second generator fails the next series of non-vital circuits is dropped, the stand-by batteries take over the whole supply function and the emergency converter is started up.

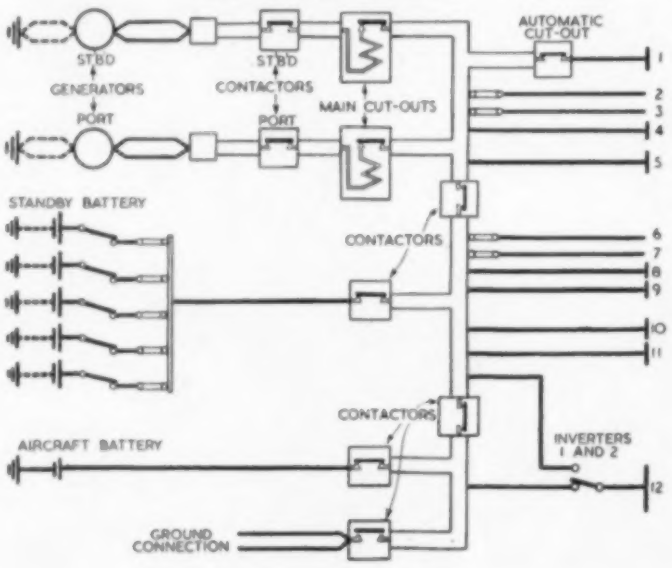
The three distribution circuits are all switched on together as soon as engine revs reach the required level after starting. A master switch isolates all electrical services when the aircraft is on the ground. A series of warning lights in the cockpit indicates to the crew how the system is working.

The hydraulic system of the Caravelle is based to a considerable extent on de Havilland experience with the Comet and contains a number of British-made components. Upon it depend the operation of flying controls and the actuation of undercarriage, flaps and several other services, including control-feel simulation, air-brakes, wheel brakes, nosewheel steering and centreing and freight and passenger access doors.

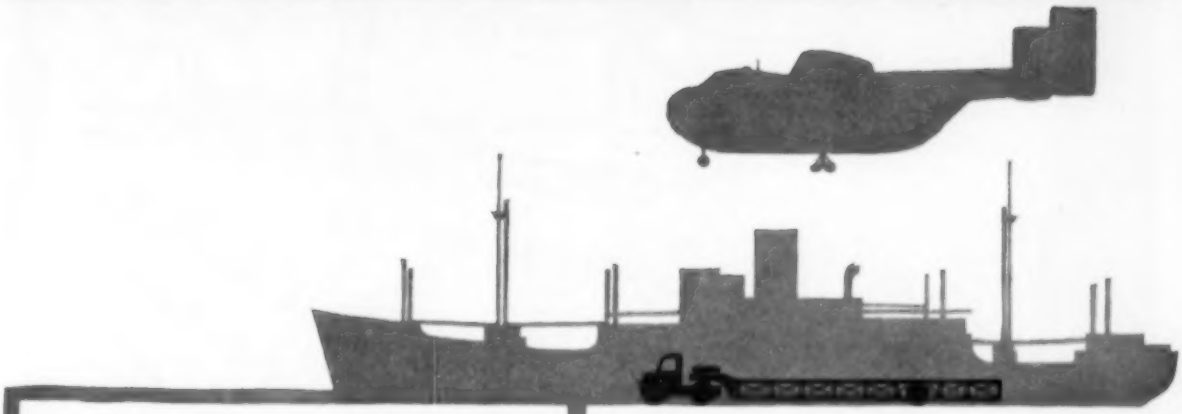
It can be seen from this just how important it is that the hydraulic system should be as nearly fail-proof as possible. S.N.C.A.S.E. have therefore designed a system based to some extent on Comet practice, but in many respects improved; and some time ago they constructed a complete working mock-up at Toulouse-Blagnac. This is dimensionally accurate, with all components laid out exactly where they would be in the aircraft. The only departure is that the aileron and air-brake lines and components have been turned through 90 deg to lie alongside the axis of the fuselage, because there was not space in the shop to accommodate the full wing-span. All parts of the system have been exhaustively tested, the undercarriage alone having been lowered and raised more than 5,500 times. The weight and mass of all control surfaces and other moving parts is simulated on the rig by weights and heavy frames, and the dynamic pressure supplied to the feel simulator can be varied to reproduce all flight speeds. The controls have already been put through 100,000 cycles without a hitch.

There are four hydraulic power supplies, identified by colours: green, blue, yellow and red. Green and blue are normal and

The Caravelle's electrical system is schematically shown here, with its three main distribution circuits. The numbered supplies are:
(1) windscreen demister fan, prototype only, (2) No. 1 converter, (3) No. 2 converter, (4) normal lighting, autopilot and radio, (5) taxying light, converter relays and radio, (6) red system hydraulic pump, (7) yellow system hydraulic pump, (8) port fuel pumps and valve control, navigation lights and lamps, hydraulic system indicators, (9) starboard fuel pumps and valve control, de-icing control, red cockpit lighting, (10) and (11) radio and (12) air-conditioning controls, generator indicators, emergency warning circuits, fire detection and suppression in the engine nacelles.



Where the GNAT LIGHT FIGHTER *scores*



6 *Mobility*

The Gnat has a tactical advantage over the standard fighter because it is small and easy to assemble. It can be carried by air freighter, ship or road vehicle with little or no dismantling, and can be given ample flight duration for ferrying by the use of long-range tanks.

Similarly, on the basis of

PRODUCTION—tooling time for production is halved, and twenty-five Gnats instead of five standard fighters can be built in the same number of airframe man-hours.

HANDLING—the Gnat is designed for outstanding manœuvrability, rapid climb and simplicity of control.

COST—twenty fully operational Gnats cost no more than six standard fighters.

SERVICING—ground-level accessibility and a minimum of equipment reduce servicing time by more than half and increase operational strength.

FIRE POWER—for the same production man-hours and money, the Gnat wields far greater fire power than the standard fighter.

Both the Gnat and its low power prototype, the Midge (pictured above), are private ventures by

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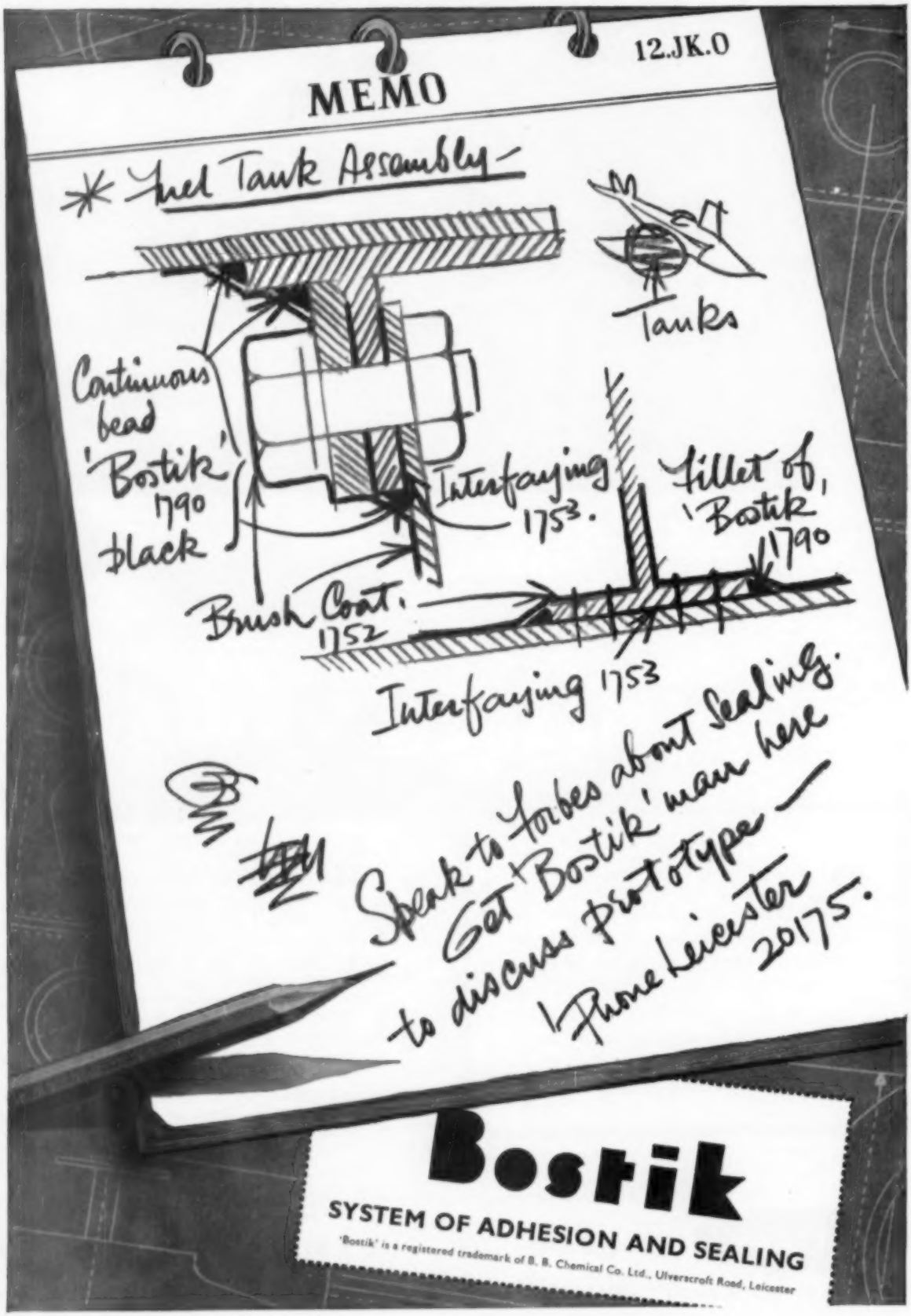
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JET-AIRLINER SYSTEMS . . .

yellow and red are stand-bys. The supplies serve components as follows: green, half of all the flying controls, and undercarriage, flaps, air-brakes, wheel brakes, nosewheel steering and passenger steps; blue, powered controls and feel-simulation. Yellow is a stand-by for powered controls and feel-simulation and red is the stand-by for undercarriage lowering, flaps, wheel brakes, nosewheel steering; and it is normally used to open the freight door.

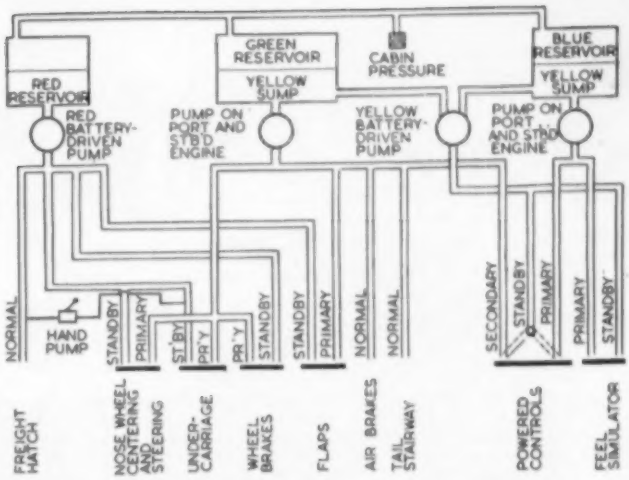
The green reservoir is on the port side aft of the rear cabin bulkhead and holds 39 litres in all, while the blue reservoir is in the corresponding position to starboard and accommodates 16 litres. A section in the bottom of each of these reservoirs holds a supply for the yellow system. The red reservoir, in the forward fuselage and holding 15 litres, is divided into two compartments, one to supply the red motor pump and the other for a hand-pump. The blue and green systems are fed by four engine-driven hydraulic pumps, one blue and one green being mounted on each engine. The blue pumps are Lockheed Mk 7 with a capacity of 14 litres/min and the green pumps are Lockheed Mk 8, 28 litres/min. The yellow system has a Lockheed Mk 7 (14 litres/min) electrically driven pump which, in case of double engine failure, can be run on the batteries alone for 30 min. Another Lockheed Mk 7 (14 litres/min) pump is electrically driven for the red system. Pressure in all circuits is 2,500 lb/sq in.

To sum up, blue is flying control primary; green is flying control secondary and services primary. Controls normally run on primary and secondary together. Yellow can draw fluid from either the blue or green reservoirs and supply pressure to either the blue or green sections of flying controls, whichever should require it. In the event of both blue and green supply to the controls failing, electrically generated yellow power can be fed into either side of the Servodynes. Should all generators fail the yellow pump can be driven by the batteries for 30 min; after that permanently charged accumulators can maintain flight control for a little more than ten complete deflections of all control surfaces. With care this can be made to last a considerable time. The control system is described in full below; suffice it to say here that it is fully powered and irreversible in all axes without provision for manual reversion.

There are seven main permanently charged accumulators. One in the blue system provides the ten full deflections of all controls; another is in the yellow system. There are several in the green system, one to maintain control pressure for 12 sec, which is the time during which undercarriage lowering or retraction requires the majority of the running effort; two more provide for one undercarriage operation in case of engine failure on take-off and another provides for passenger-staircase actuation while the engines are stopped. Two accumulators in the red circuit give stand-by power for all services and pressure for emergency operation of wheel brakes and parking brake. The undercarriage can be lowered by gravity and a special valve is provided so that fluid can run freely into the jack to eliminate drag from this source. A few strokes of the hand-pump in the red circuit are sufficient to engage the down-locks. Flaps and droop-snoot leading edge are operated by two Hobson type 197, integral 10 h.p. hydraulic motors through shafts and screw-jacks. One side of each motor is in the green circuit and the other in the red. Either supply can be selected from the cockpit as required. Full deflections of the droop-snoot and flaps require 300 turns at 600 shaft r.p.m., and after 300 turns the motor will stop within plus or minus a quarter of a turn of the pre-selected position. Rapid movement of the control lever, however, would result in hammering in the lines, and the cockpit control is therefore arranged with a spring follow-up so that flap position is selected with the lever, and a pointer moving in the lever slot shows the actual position of the flap linkage as it follows the spring pressure from the selector.

The air-brakes are normally worked from the green circuit by two piston jacks in each wing. It is not considered necessary to link these to any of the stand-by circuits. The undercarriage can be lowered, but not raised, on its red stand-by supply. All the fairing doors are mechanically linked to the undercarriage legs so that dropping the wheels by gravity will also operate the doors. There is, however, a secondary jack which assists in the movement of the large mainwheel door; the services of this jack can be dispensed with in emergencies. Nosewheel centreing and shimmy-damping are performed by the two hydraulic jacks which are used for nosewheel steering. The control in the cockpit is in the form of a small steering wheel mounted on the elbow of the port control column—an arrangement identical with that of the Comet.

Each Hispano Suiza main undercarriage leg carries a bogie of four Dunlop wheels fitted with Maxaret-controlled disc brakes and dimpled tyres. Brake power is drawn from the green undercarriage-lowering circuit and can be applied differentially to each main bogie by pedals on the rudder bar. Brake pressures, both applied and available from green and red systems, are indicated on a panel of three instruments in the roof of the cockpit. Undercarriage position indication is by micro switches and electric warning lights in the cockpit. The position of the wheels themselves are shown by the standard red and green light patterns but, in addition, there are warning blinkers indicating nosewheel unloaded (this for the prototype only) and undercarriage doors unlocked. A warning lights up, and a horn blows, if throttle is reduced below a certain point with undercarriage retracted. The horn can be switched off if desired.



Schematic diagram of the hydraulic supply. Flying controls normally operate on primary and secondary supplies simultaneously, the stand-by taking over whichever of them might happen to fail. The freight hatch, passenger stairway and air brakes need only one supply.

Windscreen wipers are hydraulic, but are operated from a completely independent hydraulic circuit with two small electric pumps. If necessary, they can be worked manually, much as can those of a car.

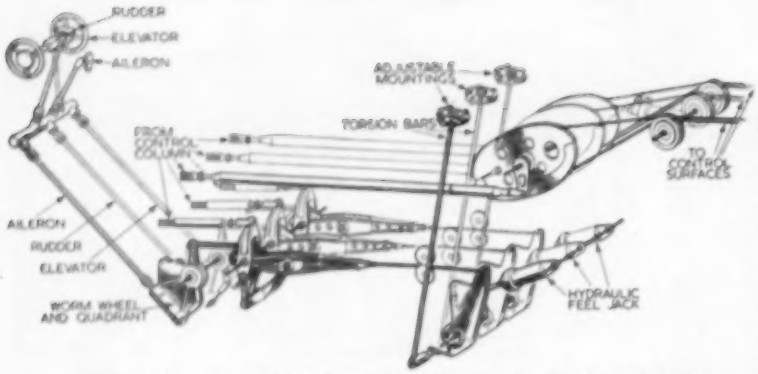
The entrance ladder under the tail is actuated from the green circuit by two piston jacks and has hydraulically operated mechanical locks. A hand-pump is available as well as an accumulator for operation when the engines are not running. It was foreseen that, in the event of a wheels-up landing, the latter steps would lie at an angle to the horizontal, making it difficult and possibly dangerous for passengers to run down them in a hurry. A linkage was therefore arranged by which, regardless of the ladder's angle, the steps themselves would always be horizontal.

The freight-loading door to port in the forward fuselage is hinged along its upper edge and operated by two jacks in the red circuit only. The door can therefore be opened by starting the red circuit electric pump, or by using the red general accumulator or through the handpump in the red circuit.

Powered Control.—The Caravelle's controls are fully powered, irreversible and hydraulically operated. In general terms, this means that the control cables from the pilot's cockpit operate the valves on the control jacks only and that all the effort required to move the control surfaces is supplied by hydraulic power. None of the forces acting on the surfaces is transmitted back to the control column. But the pilot must have some indication of the strain he is imposing on the airframe and a system is therefore incorporated to provide a force which resists stick movement. This artificial feel is made proportionate to the airspeed. When the pilot is not applying a force to the stick this feel load, like the aerodynamic load on plain controls, returns it to a neutral position determined by the setting of the stick neutral-position adjustment, which is the trim control.

To displace the valve on the jack at the control surface requires very little force and a very small movement. Any incidental distortions in the control-cable circuit, if they affect the position of the valve, will cause control-surface movements which, firstly, have not been selected by the pilot and, secondly, will be difficult for the pilot to counteract. The controllability of the aircraft—that is, its responsiveness and its stability—will be affected by any imperfection in the design and mounting of the mechanical section of the control system.

If anything so vital as the control surfaces of an aircraft are hydraulically operated, some form of stand-by must obviously be provided against the possibility of failure in the air. This can be done either by reverting to direct manual control (manual reversion) or by taking power from another source. Manual reversion, however, introduces a great number of problems, since the finely balanced mechanical section of the powered-control circuit will have to be stressed to take the full air-loads produced by control surfaces that have not necessarily been balanced and adjusted for manual control. In any case the loads in such a system on a fast, large aircraft would probably be beyond the capabilities of the average pilot. The most effective way of providing the necessary precaution is to use a stand-by source of



Trim, stick centring, feel and variable response gear under the cockpit floor. Input from the sticks is divided to serve the trim gear and cable pulleys individually. Movement of the trim linkage offsets the stick neutral position dictated by torque rods and feel jacks. The oval pulleys will later be moved out to the Servodynes leaving at this point only the autopilot input pulleys which are not shown here, but are concentric with the oval pulleys.

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power, and this is done in the case of the Caravelle.

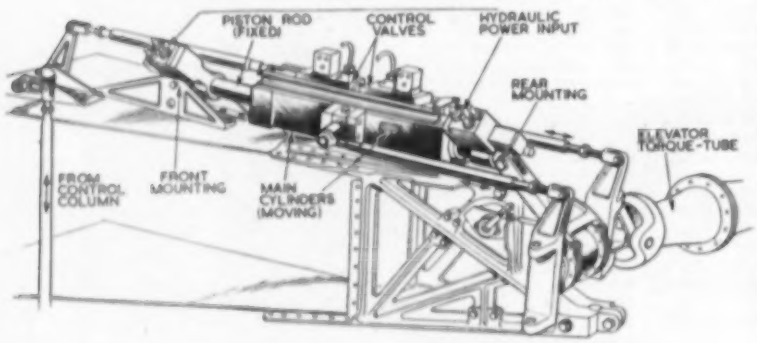
The main power units in the Caravelle's control system are Lockheed tandem Servodynes, one for each aileron, one for elevators and one for rudder. They are respectively, two AIR 42756 for ailerons, AIR 42762 for rudder and AIR 42556 for elevator. The units are made up of two jacks mounted back to back, with their pistons anchored to the structure and their bodies operating the control surfaces direct through push-rods. The power supply enters at the piston mounting, passes through the piston and is exhausted from the body. All supply lines are rigid pipes, and only the return lines are flexible.

The maximum effort of each jack is 3,100 lb at 2,500 lb/sq in, making 6,200 lb for each Servodyne unit. Not all the power available is required at each surface, but all the Servodynes are similar in construction and the effort supplied by each is fixed by using a different stroke obtained by varying the length of the hinge radius arm. The aileron units give 3,037 lb-ft with 4.72in stroke; the elevator unit 3,978 lb-ft with 5.9in stroke; and the rudder unit 3,580 lb-ft.

To provide the maximum rigidity in the surface/Servodyne linkage, the Servodynes for the elevators and rudder are mounted at one end on the control surface hinge-bracket itself. The hinge-bracket structure is then carried directly forward and the other end of the Servodyne mounted on it. In the case of the ailerons, the power unit lies in between two sections of aileron between two reinforced trailing-edge ribs abutting directly on the rear spar. The aileron hinges pass through these ribs and swinging links mounted on them are actuated by the push-rods from the Servodyne body.

To achieve maximum stability and minimum friction, the control cables are kept as much as possible in long straight runs and tensioned at 110 lb. In the fuselage these are situated immediately beneath the cabin floor and straight down the centre-line from the cockpit to the rear pressure bulkhead. Each control circuit passes only once through the pressure cabin wall and at this point the two cables are converted into a single torsion linkage. The seals at the bulkheads are glands around a rotating shaft which give at once the best pressure seal and the minimum friction.

The elevator Servodyne mounted on top of the tailplane torsion box. One end is anchored to the elevator hinge axis itself. The two halves of the unit normally work simultaneously in the blue and green circuits.



The aileron control cables pass through the pressure bulkhead immediately behind the rear spar and are thence carried in a straight line along the rear spar direct to the Servodynes. Those for the elevator and rudder pass through the rear bulkhead on either side of the sill of the passenger door and, in further short cable runs, to the Servodynes. The elevator Servodyne is mounted on top of the central torsion box structure of the tailplane within the fin, while that for the rudder is mounted on its side on a box beam running from the lower rudder hinge bracket upwards and to the left to a fuselage frame. This frame is here steadied by a triangulated structure from the reinforced fuselage frame immediately ahead of it which reinforces the passenger-access tunnel. The cables can take the greatest force applied by two pilots—1,100 lb. Valve operating force is 1-2 kg (2.2—4.4 lb) and sensitivity less than one-tenth of a degree.

Beneath the cockpit floor lies the mechanism concerned with stick-centring, feel-simulation, trim and control-surface response variation. The control columns are identical with those of the Comet and the linkage between them and the beginning of the cable runs is by push-pull rods. These rods lead to two axes mounted centrally under the floor where each circuit is duplicated, one side leading direct to the cable pulleys and the other to the trim linkage and stick-centring mechanism. From the accompanying illustration it can be seen that the pulleys are oval. By this means, the rate of control surface response to stick movement is rendered non-linear, so that towards the stick-neutral position the surface response is reduced. This greatly assists control at high speeds, when a powered control system tends to become over-sensitive. On the production aircraft the oval pulleys will be moved out to the Servodynes in order to maintain the full range of cable movement right out to the control surface, thus avoiding over-sensitivity to any play which may have remained in the circuits.

Stick force is determined by the centring action of bronze-beryllium torsion bars and by a further force proportional to the aircraft's airspeed. This is done through a Hobson feel-simulator control, type 159, which regulates hydraulic pressure in three Hobson centring jacks, sometimes called "q-pots," according to dynamic pressure sensed at the starboard pitot head.

The trim wheels, mounted in the natural sense on the control pedestal, each operate a worm wheel and a toothed quadrant which, through a push-rod, operates the differential linkage that offsets the neutral-position of each control as required. The differential linkages are connected by cable to the centring mechanisms.

Since feel and trim in such a control system are entirely artificially produced, it is possible to gain some idea of the handling qualities of the aircraft by operating the ground rig. Break-out force on the stick appears to have been eliminated and stick-centring is positive and pleasant. Stick forces have been adjusted in relation to the operational use of the aircraft and are therefore fairly large. Loads are varied according to E.A.S., thus producing q-feel. There is no compensation for compressibility effects.

Air Conditioning and Pressurization.—In conformity with modern practice the air conditioning and pressurization systems are linked with each other and rely for their charge air supply on engine compressor bleeds. Air thus drawn at comparatively high temperature and pressure from the engines is treated for temperature and for moisture content and fed into the cabin. Pressurization is obtained by throttling the outlets, and all air is dumped overboard without being recirculated in the cabin. Principal design responsibility has been shared between S.E. and AiResearch in America, practically all the components being supplied by the latter company. The de-icing system uses a proportion of the air bled from the engines.

Cabin air is bled from the 15th—and last—stage of each Avon compressor at a temperature equivalent to ambient plus 200-250 deg C, and at a rate of 75 lb/min per engine at sea-level and 45 lb/min at height. This is equivalent to 1.2 lb/person for 75 occupants at 40,000ft. Air from each bleed is passed, as required, through a heat-exchanger, brake-turbine-type expansion unit and water extractor mounted close to each engine. Each of these units can be cut out according to the temperature and moisture required, but above 19,200ft the moisture content of the air is low and the water extractors are automatically cut out by electric valves controlled by a barometric capsule on the rear bulkhead. Air reaching the cabin is automatically regulated by thermostatic cut-off so that it does not exceed 100 deg C at the delivery nozzles; this is in order to avoid any risk of melting the vinyl-sheet covering of the glass-wool insulation layer in the walls of the pressure cabin.

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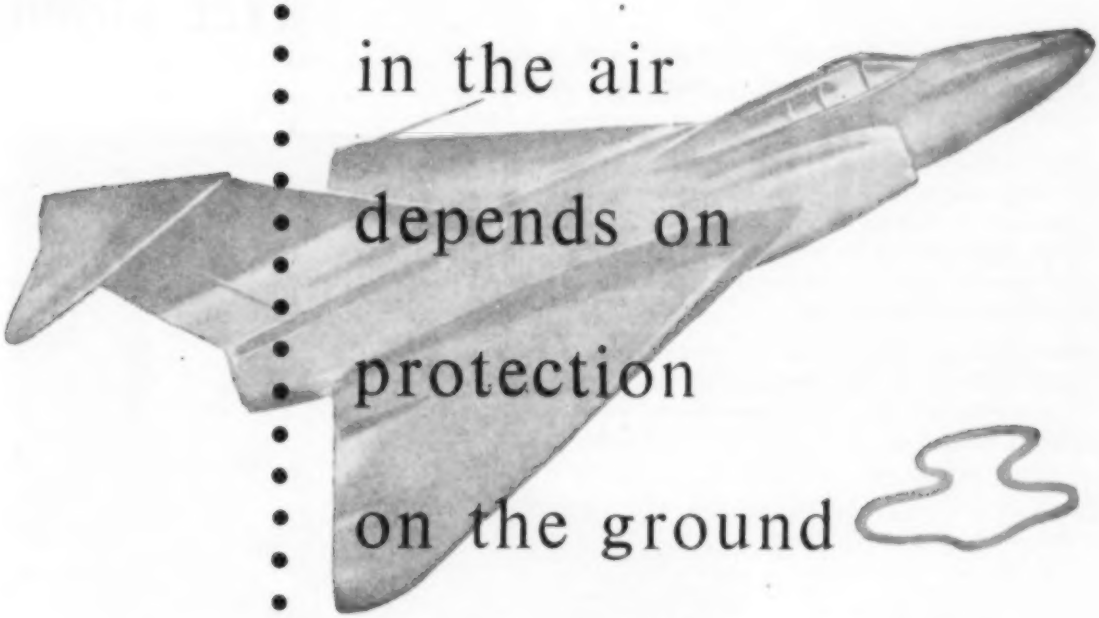

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The illustration shows the local equipment console. Both receivers, the aerial mixing unit, modulators and associated oscillators, corresponding to a twin channel equipment are all built into the one cabinet. The bearing indicator meter for monitoring is common to both channels, and can be switched to either. Remote control and display units of similar design are required for each channel. Desk mounted bearing repeater units are available for display at other points.

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JET-AIRLINER SYSTEMS . . .

The general principles of this type of system were described in *Flight* on October 22nd last year.

Cooling air for the two heat-exchangers is taken through twin ram-air intakes, located at the base of the fin, and downwards through ducts to the heat-exchangers behind the cabin rear pressure bulkhead; it is then released through outlets under the rear fuselage. The air for the brake turbines is drawn from the ducts downstream of the heat-exchangers and returned there. As can be seen from the diagram, ducts and valves are so arranged that various of the elements in each circuit can be cut out, and a series of temperature-sensers in the ducts supply signals for automatic controls and gauges.

From the main temperature-adjustment system the air from each group of units is led into a common pipe which is then divided again into three branches, two for the passenger cabin and the third for the crew compartment. Where the pipes join, there is a separate intake through which conditioned air can be supplied to the cabin from a trolley while the aircraft is on the ground.

The main duty of the system is cooling, because the cabin insulation is good, and the main air supply from the engine compressors very hot; and the occupants of the cabin and cockpit themselves provide one of the main sources of heat—S.N.C.A.S.E. have calculated that each passenger will produce 75 calories of heat and each crew member 100 calories. In addition to normal cooling for passengers, however, the system is designed also to provide cabin temperatures down to plus 5 deg C, this being an acceptable level for perishable freight. Incidentally, it is not thought necessary to paint the roof of the aircraft white for cooling purposes, since it has been calculated that the average heat-relief on the ground is in the region of only 5 to 9 deg; but the prototype bears S.E. colours which include a white roof.

Air leaving the expansion turbines is heavily moisture-laden and the water separators extract from it about 60 to 70 per cent of the water droplets, thus reducing the likelihood of misting in the cabin, while also acting as conditioning-system silencers. If, however, the charge air passing through the separators is at less than 0 deg C there is a likelihood of ice forming there. A subsidiary bleed from the main charge air supply has therefore been incorporated which, under thermostatic control, adds fully hot air to that flowing through the separator to keep the charge air always at about plus 2 deg C.

Above 19,200ft, when the water separators are cut out air can be delivered to the cabin at well below 2 deg C. The water-separator cut-off valves can be switched from both the pilots' and steward's control panels, so that the barometric cut-out can be anticipated should fully cold air be required when not normally automatically supplied. Ten to fifteen minutes after a hot-weather take-off the cabin may still be rather warm, and it is therefore foreseen that during such periods cold air will be required.

If a ground trolley has been connected for conditioning on the ground, it is possible that the windscreen will mist up during take-off. A separate air intake in the nosewheel bay has therefore been installed in the prototype to pump air through electric heaters to the windscreen. This was asked for by the test pilot and, in production aircraft, it will be replaced by a secondary bleed from the main charge-air supply.

There are two Teddington Controls on/off cocks by which each system can be completely isolated from its engine bleed; but, in addition, the closing of either throttle actuates the cock for the related engine. In case of an engine fire or a crash landing, therefore, the systems are automatically cut out and fumes or smoke from the engine are prevented from entering the cabin or cockpit.

There is, in the windscreen sandwiches, one further small system. Most panels have double layers of Perspex—the inner of which takes cabin pressure—but those directly in front of each pilot have the outer panel of glass, to prevent scratching by the windscreen wipers. These glass panels do not take the cabin pressure, which is here held by the inner Perspex. This causes the gap between the two, which is at outside pressure, to vary as pressure is released or applied, and, of course, the air space changes in volume. A breather tube is therefore led to each panel from the nosewheel bay, through a silica-gel capsule which keeps the contained air dry.

For conditioning control purposes the cockpit and cabin are treated as separate units; and the system is intended for automatic operation. There is, however, a full set of warning devices and direct controls and gauges to enable the crew to deal with unusual situations and possible failures.

For both halves of the system there are also cabin and duct temperature gauges and warning lights indicating excessive temperature. Normally the two main bleed-valves are opened to start the systems and temperature can then be controlled in two ways. First two rheostats can be set at the desired level and the system switched to "auto." The rheostat dials are not marked in degrees since a given setting will produce different temperatures at various altitudes, but it is simple to make adjustments according to requirements. Secondly, the systems can be switched on and one of two buttons pressed, whereupon the temperature will continue either to rise or fall until the "auto" button is pressed. Temperature is thus easy to regulate, yet there is full indication of the behaviour of the system.

In the prototype Caravelle, both control panels are in the cockpit, but in production aircraft the pilots will control their own (the port) system and the other will be controlled by the stewards from a separate panel in the passenger cabin.

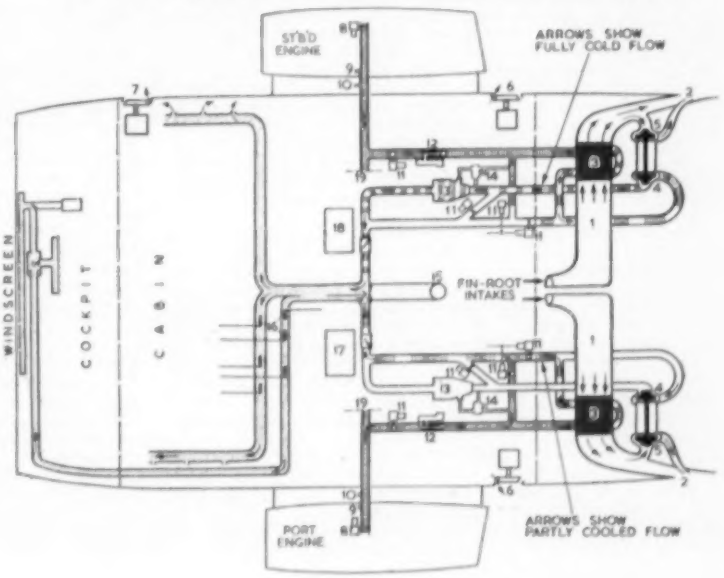
Pressurization.—The air-conditioning airflow through the sealed cabin is throttled at the outlet to maintain pressurization, and for this purpose there are three outlet valves; two are automatically regulated and the third manually, the automatic ones being in the underside of the tail of the pressure cabin, and the manual one on the rear top face of the nose-wheel bay.

Cabin pressure and the rate of change of pressure can be controlled from the cockpit at a panel next to that for the air-conditioning system. The indicating instruments are a cabin altimeter, a separate aircraft altimeter and a variometer, these being grouped with warning and control devices for extremes of pressurization. The main control is a dial on which the crew can select cabin altitude and rate of change.

The pressurization valves, like the air-conditioning system, are the work of AiResearch. The normal rate of change of cabin altitude will be set at 2.6 m/sec (500 ft/min), but the available range is from 50 ft/min to 2,000 ft/min. The normal working cabin differential is to be 8.05 lb/sq in with a regulated maximum of 8.2 lb/sq in. At 8.5 lb/sq in, all three valves will open and hold cabin pressure down to the regulated maximum level, although one of the valves alone has sufficient capacity to meet any over-pressurization case should valves stick shut. They are designed to provide automatic inward pressure-relief as well, and are set to open fully for an excess of pressure of 0.1 lb/sq in.

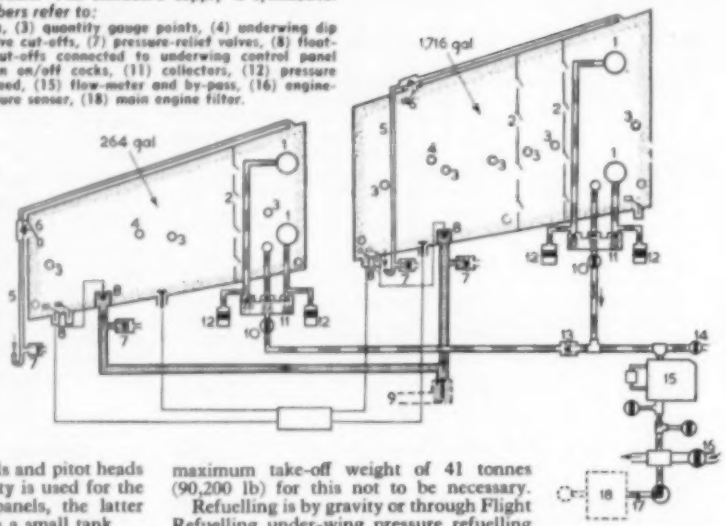
It is intended that, during stacking over an airfield, the cabin atmosphere should be raised to sea-level pressure so that the most rapid possible descent could thereafter be made without causing discomfort to passengers. There is an independent pressure-

Air bleed from the Caravelle engines is used for air conditioning, pressurization, de-icing and fuel heating as shown in this diagram, which is concerned mainly with air conditioning.
(1) ram-air ducts, (2) vent to atmosphere, (3) two-pass heat-exchangers, (4) expansion turbine on the same shaft as (5) brake turbine, (6) automatic (normal) pressurization valves, (7) manual (stand-by) pressurization valve, (8) main on/off cock, (9) engine intake de-icing bleeds, (10) fuel heating air bleeds, (11) system on/off, automatic temperature control and water separator cut-off valves, (12) flow valve, (13) water separators and (14) their de-icing sensers and regulators, (15) ground conditioning trolley connection, (16) temperature sensers for indication and control, (17) cockpit control panel, (18) steward's control panel, (19) wing and tail de-icing air supply.



JET-AIRLINER SYSTEMS . . .

Schematic diagram of the port fuel circuit. The starboard supply is symmetric. The numbers refer to:
(1) immersed pumps, (2) flap valves in ribs, (3) quantity gauge points, (4) underwing dip sticks, (5) ram-air intakes and (6) float valve cut-offs, (7) pressure-relief valves, (8) float-controlled automatic pressure refuelling cut-offs connected to underwing control panel and (9) underwing filling point, (10) main on/off cocks, (11) collectors, (12) pressure gauges, (13) non-return valve, (14) cross feed, (15) flow-meter and by-pass, (16) engine-bled heating air, (17) temperature sensor, (18) main engine filter.



senser in the cabin which actuates a red light as soon as cabin altitude exceeds 3,000m (9,880ft).

The valves are intended to be opened manually immediately before landing, but in addition a micro-switch on the undercarriage causes them to open fully as the wheels come down.

Although primarily automatic, the system can be manually operated from the pilots' position, using the valve in the nose-wheel bay alone.

De-icing.—The leading edges of the tail surfaces, wings, engine air-intakes, heat-exchanger ram-air intake, windscreen main panels and pitot heads are all protected against ice formation. Electricity is used for the pitot heads and alcohol for the windscreen panels, the latter system using normal hand-pumps supplied from a small tank.

The remainder of the de-icing is by hot air taken from the main compressor bleeds serving the air conditioning and pressurization system. Hot air is ducted inside the double skin of the leading edges to keep the surfaces just above 0 deg C, temperature control closely resembling that for air conditioning. Selector switches can be set for "auto," "increase," or "decrease." Bleed temperature varies according to engine speed, but delivery temperature is varied by altering the volume of air bled, first demand being made on one engine only and then on both. The flow available from one engine is, however, considered sufficient for full de-icing, so that the engine-out case here is not critical.

An ice-detector probe is mounted under the nose and set to illuminate a warning sign in the cockpit when ice begins to form. The de-icing air supply is then switched on and the temperature of the leading edges and of the air in the duct registered on gauges, which indicate the performance of the system. About 30 deg C is lost in the ducts, so that the air reaching the surfaces is at about 200 deg C. The control panel in the cockpit is in the same group as those of the air conditioning and pressurization controls, with the icing warning light in the roof panel.

The Fuel System.—The fuel capacity of the Caravelle is given as 18,000 litres (3,959 Imp. gal) with an absolute total of 4,839 gal, all of which is contained in four integral tanks in the wing torsion-box structure. The main (inboard) tanks hold 7,800 litres (1,715 gal) each and the outboard tanks 1,200 litres (264 gal) each. S.N.C.A.S.E. do not consider placing extra tanks in the fuselage centre-section and would not take any responsibility for such an installation.

The tanks themselves are integral with the torsion-box spar structure; the company does not consider that the extra complication and risk of leaks justifies pressurization, though the tanks are stressed for it. The system is designed for automatic feeding to the engines and for either gravity or underwing pressure refuelling. The order of draining is main and then outer tanks, a senser being provided so that, when the fuel in the main tank reaches a certain level, the pumps in the outer tank are automatically switched on. It is intended that the outer tanks should be emptied last, since the weight of the fuel in them balances the wing. The wing is nevertheless strong enough to allow the aircraft to be flown with a full load in the fuselage and tanks empty (though this is obviously an academic consideration) without exceeding the design loading limit.

Fuel is drawn from each tank by two Self-Priming B.P.22 immersed pumps (identical with those used in the Comet), *via* a small collector-chamber in the base of each tank. Should both pumps in a tank fail the engine pumps would, it is considered, have no difficulty in drawing fuel by suction. If the tank sequencing gear fails the pumps and valves can, of course, be switched direct from the cockpit. Simple valves over the gaps in the ribs in the tank bays prevent fuel from being "sloshed" outwards towards the tip and away from the pumps which lie inboard. A small ram-air intake to each tank provides ventilation and a degree of pressurization. Float valves are arranged to prevent these intakes syphoning.

It is possible, by a cross-feed system controlled from the cockpit, to balance the quantities of fuel in each wing and to cross-feed, should this become necessary. There is, however, no provision for fuel jettisoning, since the maximum landing weight of 36 tonnes (79,200 lb) is considered to be sufficiently close to the maximum take-off weight of 41 tonnes (90,200 lb) for this not to be necessary.

Refuelling is by gravity or through Flight Refuelling under-wing pressure refuelling valves. Under each wing there is a refuelling control panel mechanically connected so that, when opened, it opens the tank vent valves in the relative wing. Two float valves in each tank close the inlet pipes as soon as the tanks are full.

The main fuel supply pipe to the engine on each side passes inside the wing-root filler and through the fuselage for only 1.5m (4.8ft), and then it is encased in a straight stainless-steel tubular duct which is at ambient atmospheric pressure. Thus no fuel passes through pressurized cabin atmosphere. A flowmeter measures flow from each engine, but can be cut out of the circuit and by-passed if required. Provision is also made for heating the fuel by passing it through a heat-exchanger supplied with hot air from a subsidiary lead taken from the main compressor bleed. The temperature of the fuel is sensed immediately short of the main filter, the indicating instrument being placed on the fuel panel in the cockpit, next to an external temperature gauge.

The supply systems for both engines are identical, each side being connected only through the cross-feed circuit. For normal control the pilot simply opens the main supply cocks and switches on the pumps of the two inboard tanks. Short of a failure, the fuel system will then look after itself automatically.

IRVING-SALVATOR AGREEMENT

A RECIPROCAL agreement between the Irving Air Chute Co., Inc., manufacturers of the Irvin parachute, and S. A. Aerostatica of Rome, manufacturers of Salvator parachutes, has been announced by officials of the two companies, Irving's president, Leslie L. Irvin, and Aerostatica's Col. Prospero Freri. By virtue of the agreement, Irving and its associate companies acquire sole world rights for all Aerostatica products and Aerostatica have exclusive rights for all Irving products in Italy. The agreement adds an important link in the Irving world organization, which includes subsidiaries and affiliates in the U.S.A., Canada, England, France, Sweden, Australia and Spain.

Irving Air Chute of Great Britain, Ltd., are one of the largest companies in this chain; their two factories at Letchworth cover a floor space of 46,000 sq ft and employ over 350 people. Their activities are not only concerned with the manufacture of parachutes and associated equipment for the British and foreign governments, but include a large research and development department which is occupied with, among other things, the numerous problems arising from the use of parachutes with modern high-speed aircraft. In addition, the company is responsible for the maintenance, repair and packing of all parachutes used by the 16th Airborne Division (T.A.).

POGO PROBLEMS

DURING a recent meeting of the Montreal Chapter of the Canadian Aeronautical Institute, Mr. O. F. Oldendorph, senior design engineer of Convair, San Diego, described some of the difficulties encountered in the development of the XFY-1 vertical take-off prototype. One of the major problems was to establish a comfortable posture for the pilot; eventually this was done by arranging for the seat and cockpit controls to tilt through 45 deg under push-button control. The engine, an Allison T40 double turboprop, also required modification, and the electric batteries were pendulum-mounted so that they could not spill acid.

NORAL ALLOYS

are used in the Gloster Javelin,

as in all of Britain's

outstanding

aircraft

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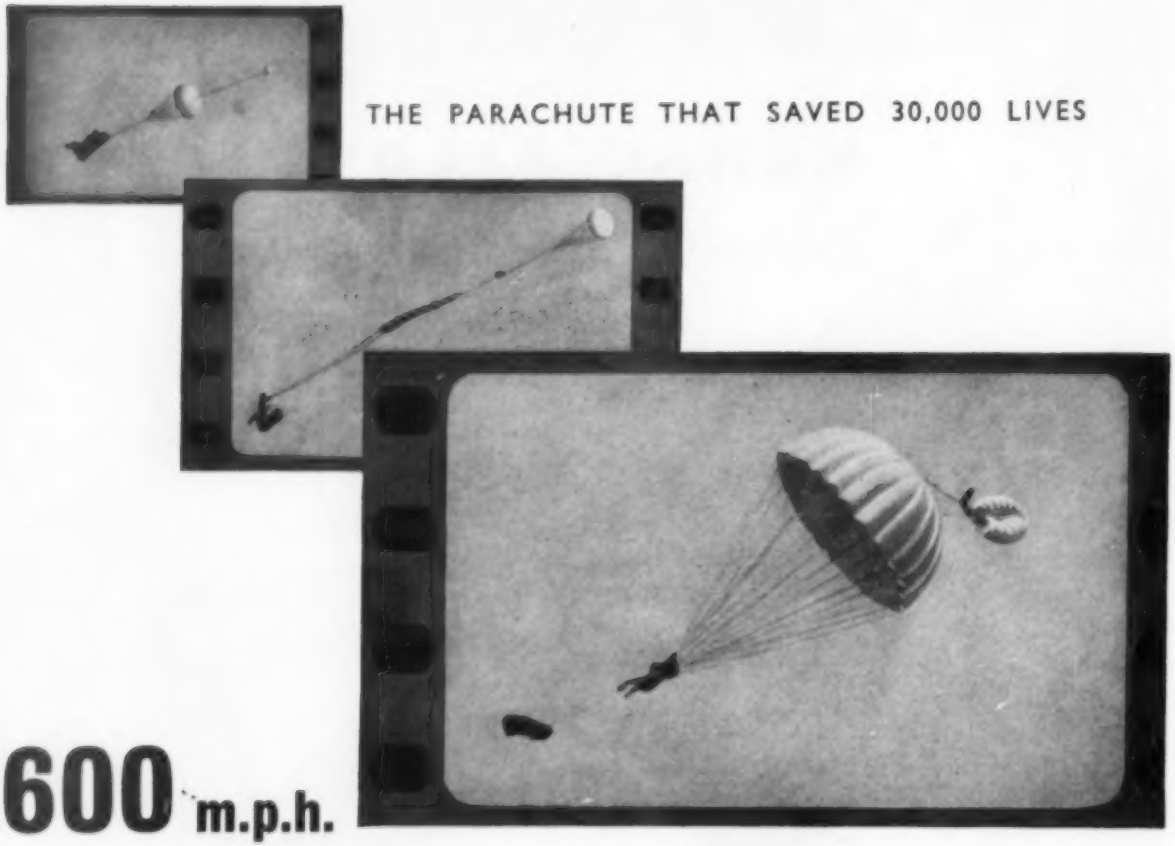


THE PARACHUTE THAT SAVED 30,000 LIVES

600 m.p.h.

at ~~150 feet~~ *50 feet*

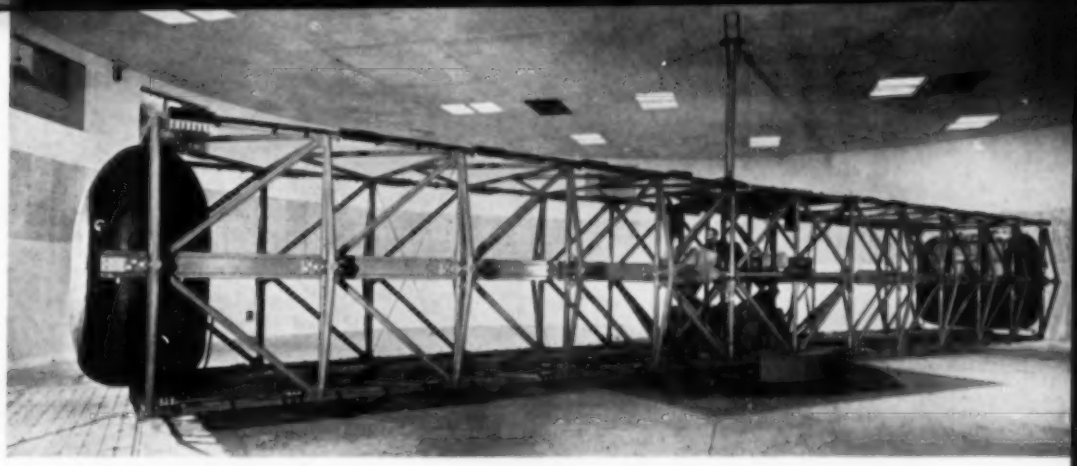
—still the safest parachute

In a more recent test of a Martin-Baker Patent fully Automatic Ejection Seat, an ejection was made from a Meteor 7 aircraft in straight level flight at 600 m.p.h. and only ~~1~~50 feet up. Three seconds after ejection this IRVIN 24-feet parachute was fully deployed before alighting. It was this same canopy design that saved the lives of 30,000 airmen during the war.

IRVIN

THE IRVING AIR CHUTE OF GREAT BRITAIN LIMITED
LETCHWORTH, HERTS, ENGLAND

Telephone: Letchworth 888 *Telegraphic Address:* Irvin, Letchworth



The centrifuge in its lair. The gondolas can be mounted at five points along the beam. Control cabin windows can be seen at upper left.

MAN-CARRYING CENTRIFUGE

New Acceleration Research Rig for Institute of Aviation Medicine

A MAN-CARRYING centrifuge, the most modern of its kind in Europe, has been completed at the R.A.F. Institute of Aviation Medicine, Farnborough, and was officially inaugurated on Tuesday last week by Viscount Thurso (who was Secretary of State for Air from 1940 to 1945). Its design and construction were begun soon after the war and it has taken some three years to install in its circular, reinforced concrete chamber.

The machine consists of a 60ft girder-type beam mounted on a vertical-spindle D.C. driving motor sunk into a pit in the floor. At each end of the beam a stressed-skin gondola, of aircraft-type construction, contains either a test subject or a balance-weight. Close to the centre of rotation there are two positions for observers, who, travelling with the beam, keep the subject under direct observation. The principal control station is behind glass panels high up in the wall of the chamber, and a further department in the upper regions of the building is equipped to record such factors as the subject's heartbeat, pulse-rate, ear opacity, g-suit performance, and acceleration.

The purpose of the machine is primarily to study, under ideal experimental conditions, the effects of g on human subjects and also upon aircraft equipment of various types. To this end, the centrifuge can simulate and repeat as often as required a given acceleration programme, providing a uniformity of repetition which it is impossible to obtain by actual test flights. The highly sensitive recording apparatus, moreover, could not be taken aloft.

Each of the test gondolas weighs 1,150 lb (alternative gondolas may weigh up to 1.5 tons) and the machine is capable of rotating the two types of gondola respectively at 115 m.p.h. and 66 m.p.h., providing an acceleration in the first case of 30 g and in the second of 10 g. Developing 2,200 h.p., the motor can bring the centrifuge up to the maximum of 54.4 r.p.m. in 9 sec.

Control can be either automatic or manual and, in the former case, the programme is governed by one of a series of cams and the timing adjusted to give acceleration times of 9, 12, 18, or 30 sec. An aircraft-type control column mounted in the gondola and at the control position can be used for manual control of g, but comprehensive over-rides and safety devices are provided, firstly to prevent overstressing the subject or the machine and secondly to bring the machine quickly and safely to rest should a mechanical failure occur. The walls of the chamber are 2ft thick, the doors are armour-plated, and the gondolas are stressed to a maximum of 120 g. A complete intercommunication system ensures voice contact between all concerned, with a system of priorities so that more urgent messages will not be delayed.

The original contract for the centrifuge was placed with M. B. Wild and Co., Ltd., of Birmingham; the tube structure of the beam was fabricated by Air Service Training, Ltd., the gondolas are by M. L. Aviation, Ltd., and the electrical power and the control system is by the General Electric Company, Ltd.

The timing and programming cabinet, showing a cam set up for a "run" with a live subject. The cam controls the amount, and a clock the duration, of g during each test.

(Left) The control compartment, with stick for manual control in use. The timing cabinet is at left.

(Right) The recording machine, upstairs, produces its series of readings on a continuous sheet of paper.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

British Prestige in America

I AM sorry I have not been able to write to you earlier about an article which appeared in *Flight* on April 15th entitled "British Air Prestige in America." The subtitle of this article indicates that the writer of the article feels that there is a serious lack of publicity for British aircraft in North America.

I do not wish to discuss the question of publicity, but your correspondent—"A.B.T."—goes a great deal further than this and suggests that, both in informed and uninformed circles in the U.S., British air prestige has lapsed seriously during the last twelve months. He goes even further and suggests that the enquiry into the Comet accidents has contributed to this loss of British prestige. He speaks of "an almost slanderous attack in a vast section of the American Press."

I read a number of reputable American daily and weekly non-technical papers and I also study American aviation journals. I travel around a good deal in the United States. My understanding of American opinion differs very greatly from "A.B.T.'s" In particular, I have never heard anything but the greatest admiration for British integrity, not to say scientific and engineering ability, expressed in connection with the Comet enquiry. To say that the American Press has made a slanderous attack on British aviation seems to me to be incorrect and unfair.

It so happened that I read this article immediately after returning from a panel meeting of the Society of Automotive Engineers held to compare British and American practice in the field of aircraft turbine design and manufacture. At this conference American speakers went out of their way to express admiration for British methods and British products and they expressed themselves as being more than aware of British pioneering in the field of turbine-engined civil aircraft. Nothing could have been more generous than their attitude.

I think that "A.B.T." has been too extreme in both directions, for I do not remember any time when the Americans "accepted as readily Great Britain's leadership in the air as they had once her supremacy on the seas."

I think that any Britisher over here who has some knowledge of the facts should endeavour to put this matter in a fair perspective.

Washington, D.C. S. SCOTT-HALL.

The Channel Wing

I WAS most interested to see the letter which inquired about channel-wing developments. I have not heard of anyone else working on these lines in this country, but I have taken a great interest in them myself; and, back in 1947, I conducted a series of experiments with various forms of channel. I was at that time especially interested in the possibilities of jet lift, to which this form lends itself. (Could I dare claim to be first to think of this combination?)

Going back to first principles, which is always an instructive exercise, it seemed to me that the principle of sustained flight by the indirect use of engine power was a rather inefficient way of doing things, for in most aircraft the lift is not provided by the direct action of the slipstream from the props, but by the reaction of the air and the moving wing.

A far more efficient lift is provided by the system recently decribed in *Flight*, in which a region of high pressure is created directly under the wings. This appears to be the only case where it is of real benefit (structural considerations apart) to have the props on the leading edge, where their presence normally creates further problems of form drag. Even more efficient lift is provided by sucking the air along the top of a channel wing, Custer style. The gain in efficiency by direct use of the slipstream is remarkable. Even higher efficiencies would be obtained, I contend, by a combination of these principles and modified wing shapes. Flying at very low speeds with high lift does bring us to a limiting point where quite modest turbulence in the air will produce correspondingly high changes in attitude, and make for difficulties in control.

I understand the Custer wing was invented around 1943, and wind tunnel tests were performed by the (then) U.S.A.A.F. in 1946, at Wright Field. It is said that this shape has very high values of C_L, but it is difficult to calculate as the ordinary formulæ are derived from considerations of long spans with corrections for finite sections, and there is also gain from the compressibility effect in flight, due to wing shape. Doubtless you will be able to tell us more of the latest tests, but it was calculated that 75 per cent of the lift was generated before the craft moved forward, this being achieved by sucking the air over the top surface. Many interesting alternatives suggest themselves, such as the result of combining this with the blowing principles mentioned earlier, or the application of jet lift using a turboprop, to mention a couple of idle fancies.

Of the snags, the first one Custer hit was that no one would fly such a queer thing, which pinpoints the lack of control surfaces. No flaps, ailerons or dihedral to take the strain. Even so, it flew! It does seem that any sudden change in turbulent conditions of the angle of attack would lead to equally sudden stall, with that sharp edge. This is aggravated at low speeds by the great increase of resistance to turbulent as compared with laminar flow in bodies of this shape (see 7th-root law). It is this more than anything which militates against the prospects of vertical take-off, either with this scheme or with jets. For high safety, a complete control of the airstream on both upper and lower surfaces is called for at zero speed, and to date only the helicopter approaches this ideal.

I believe that these snags could be overcome, and that the wing shape could be modified to approach even nearer to the theoretically ideal ellipsoid shape (and the devil take the production difficulties!). But then I am only a freelance, too, and I don't think the British companies would pay us much attention either; and, even if they did, it would probably not be worth the worry and the bother by the time the Government had taken the lion's share of the proceeds.

Castletown, Isle of Man. MICHAEL B. HAWTON.

Armstrong and the Camel

IT was with pleasure that I found, in reading the article on the Sopwith Camel in your issue of April 22nd, reference to a certain Capt. Armstrong. In the past I have myself written a number of articles about this pilot, in various journals, and it is gratifying to find that after 37 years he is not forgotten.

I first witnessed Armstrong's extraordinary ability to exploit the astonishing manœuvrability of the Camel in unusual circumstances. This was when I was coming in to land at Waddon in an Avro 504 one evening in 1918. Below me I spotted a Camel flying at zero feet (as its shadow indicated) and then, a moment or two later, I saw it going up in a vertical climb immediately in my line of flight. I continued to watch the machine and saw it inverted immediately above me and go down in my rear to complete the lowest, neatest and tightest loop I had ever seen.

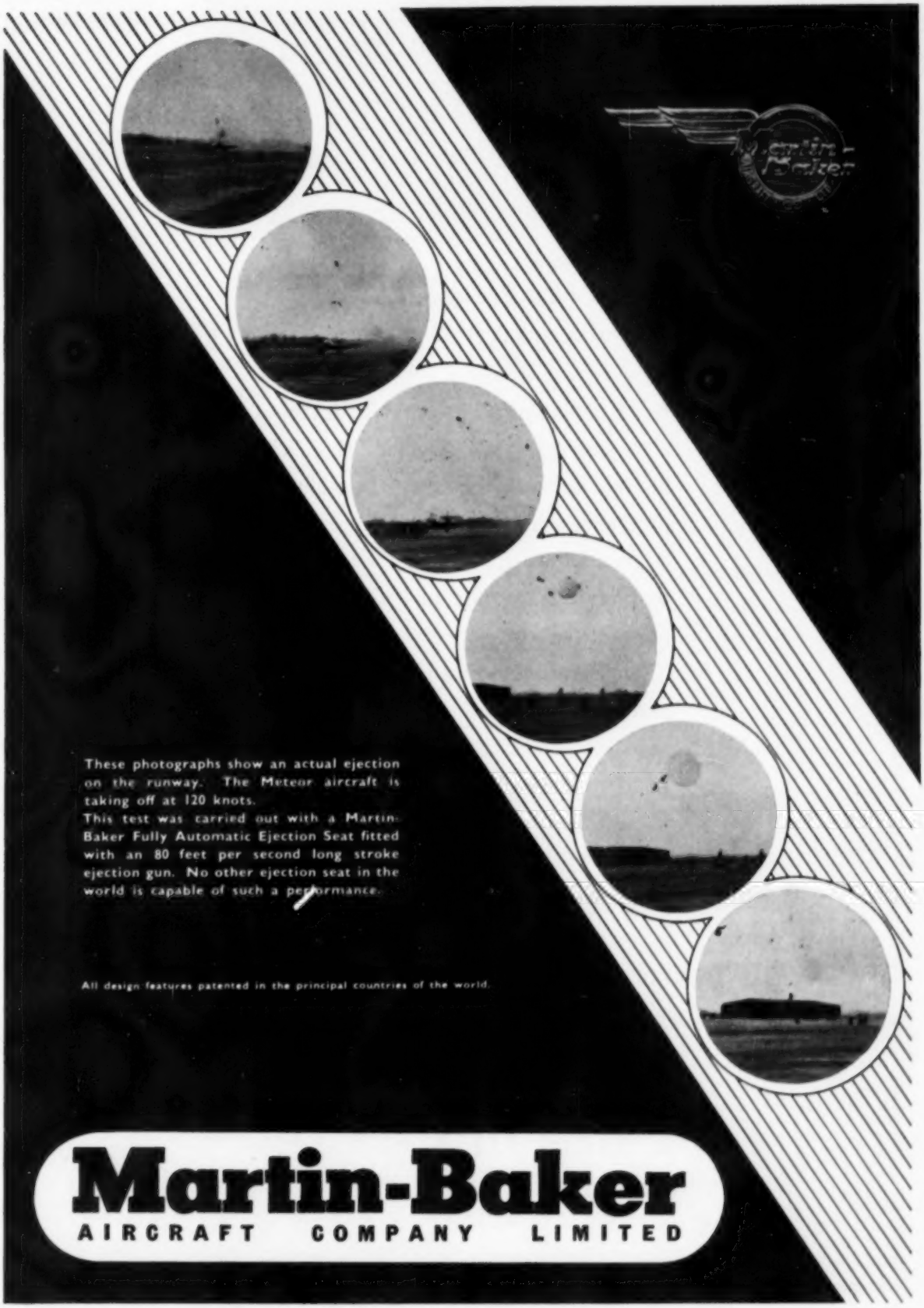
Some weeks later Armstrong appeared again at Waddon. He flew across the aerodrome so low that his wheels brushed the long grass and, on reaching the tarmac fronting our Bessoneau hangars, carried out a flick roll which left every spectator speechless. His wing-tips cleared the ground by not more than 12 inches. He proceeded to carry out a number of circuits and repeated the performance with loops and rolls again and again before landing. Our C.O. emerged from his office demanding to know in furious terms who had been indulging in this sensational and hazardous flying; but subsequently he melted and invited Armstrong to the mess for lunch.

From time to time in the past 30-odd years I have met people (including an ex-pilot of the U.S. Army Air Corps) who have enquired as to whether I had ever seen "a fellow named Armstrong" fly a Camel. I remember, too, Sir Christopher Quintin Brand saying to me that Armstrong was, in his opinion, the finest and most accomplished Camel pilot he had ever met.

London, S.W.1. GRENVILLE MANTON.

FORTHCOMING EVENTS

May 27. Royal Aircraft Establishment: Senior Staff Mess Ball.
May 28-29. Fréjus St. Raphaël Air Rally, France.
May 29-30. Aero Club of Ireland: Flying Display.
May 29-30. S.M.A.E.: British National Model Aircraft Championships, R.A.F. Station Waterbeach.
May 30. R.Ae.C.: Second National Air Races meeting (in conjunction with S.S.A.F.A. air display), Yeadon.
May 30. Royal Netherlands Aero Club: International Air Display: Ypenburg.
May 30. Women's Junior Air Corps: Air rally, White Waltham.
May 30-June 10. Canadian International Trade Fair and Air Show, Toronto.
June 1-11. Aluminium 1955 Exhibition: Royal Festival Hall, London.
June 1-11. British Plastics Exhibition and Convention: Olympia, London.
June 1-18. Royal Tournament, Earls Court, London.
June 3-17. Aeronautical Union of Jugoslavia: Sixth Federal Gliding Contests, Jugoslavia.
June 4-5. Ninth Rally of the Wines and Chateaux of Anjou, France.
June 4-5. Royal Air Forces Association: Annual Conference.
June 7-15. French Aero Club: F.A.I. 50th Anniversary Rally, Paris.
June 10-19. Paris Aero Show.
Sept. 5-11. S.B.A.C. Show, Farnborough.



These photographs show an actual ejection on the runway. The Meteor aircraft is taking off at 120 knots.
This test was carried out with a Martin-Baker Fully Automatic Ejection Seat fitted with an 80 feet per second long stroke ejection gun. No other ejection seat in the world is capable of such a performance.

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There are vacancies for all grades of design and engineering staff at Warton (situated on the Lancashire coast near Lytham St. Annes) and for designers, draughtsmen and stressmen at the Acton Drawing Office.
Interviews can be arranged at Warton or London as required.

Apply in the first instance to Department C.P.S.
Marconi House, Strand, London WC2

'ENGLISH ELECTRIC'

'ENGLISH ELECTRIC' MARCONI NAPIER

Subject of this early morning scene at London Airport is Hunting-Clan Viscount G-ANRR, first of the type to wear the colours of an independent airline. Delivered on May 12th, the aircraft left London that day for tropical trials in Africa.

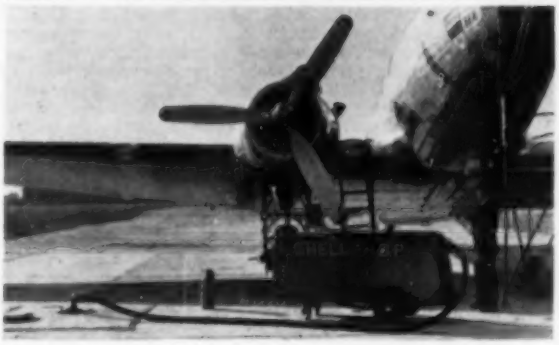
CIVIL AVIATION

VISCOUNTS FOR U.S. STEEL CORPORATION

AMERICAN sources say that the United States Steel Corporation has ordered three Viscounts for delivery in 1956. The aircraft would be executive versions, and are presumably required to replace the Corporation's DC-3s, which are based at Pittsburgh and maintained by Capital Airlines. No official statement has yet been made by U.S. Steel or Vickers, but the report is believed to be reliable.

UP TO EXPECTATIONS

WITH the replacement of North Stars with Viscounts on the Toronto to New York route on April 4th, T.C.A. have succeeded in attracting a large share of the traffic formerly carried by American Airlines. The extent of their success is shown in new figures outlining the results of the first month of Viscount operations. In March, the airline's North Stars carried 6,163 passengers at a load factor of 75.5 per cent; their share of the total passenger traffic on the route was 42 per cent. In April, when five Viscount flights daily were introduced in place of three North Stars, 9,682 passengers were carried at a load factor of 90.4 per cent; T.C.A.'s share of the traffic rose to 54 per cent. The number of seats offered on this route by T.C.A. in April increased by 31 per cent (due to the added frequency) and the number of passengers carried increased by 57 per cent.



PANAM'S POLAR PLAN

LAST week P.A.W.A. announced the filing of an application with the C.A.B. for approval to operate a trans-Arctic service from four West Coast cities—Los Angeles, San Francisco, Portland and Seattle—"to London and other points in Europe." The airline's executive vice-president, Col. C. M. Young, said that PanAm were seeking to provide competitive U.S. flag services over a route now "exclusively in the hands of foreign flag carriers."

During the forthcoming summer season PanAm will be introducing their new DC-7Bs on the North Atlantic route. These aircraft, longer-range versions of the DC-7 used by American domestic airlines, will be operated in 71-seat tourist-class form, increasing the airline's passenger capacity during the peak period by more than 30 per cent. PanAm's "Super-Seven" services between New York and Paris will begin in June, with flights operating daily in each direction. Daily services between New York and London will be inaugurated the following month. The DC-7B is designed to operate non-stop transatlantic services (eastbound) with high regularity; its scheduled time from New York to Paris will be 11 hr and from New York to London 10 hr 15 min.

HYDRANT FUELLING AT EASTLEIGH

EASTLEIGH, Southampton, recently became the first British airport to adopt the post-war system of hydrant fuelling, now being used regularly by B.E.A. Pionairs and Silver City Airways Freighters. The system was installed, with M.T.C.A. approval and co-operation, by Shell-Mex and B.P., Ltd., at a cost of around £10,000. Shell-Mex and B.P.'s future policy will be to use hydrant fuelling systems "wherever it can be shown economically" that they are more satisfactory than mobile fuellers.

Eastleigh was chosen, after consideration of several other British airports, as the site for a pilot system intended to give practical experience of hydrant fuelling. Among factors considered in the choice of site were compactness of the refuelling area, ability to lay pipeline without excavating the apron, and the prospect of future development of traffic at the airport.

As installed at Southampton, the system comprises a 12,000-gal tank of 100-octane spirit feeding seven hydrants *via* a 900ft line of 6in steel piping. The main pipeline was buried at a depth of about 2ft 6in in soft ground at the outer edge of the apron and protected with a solid concrete cover; the seven connections emerge on the standing area proper. Fuel is fed to the connections by an electrically driven Pegson centrifugal pump at a pressure of 60 lb/sq in. Maximum output is 240 gal/min, or 80 gal/min if three hydrants are being used automatically.

Fuel is piped into the aircraft *via* a Minima dispensing trolley incorporating input and discharge hoses, air separator, meter, micro filter and control valve (so that delivery pressure can be pre-set to the figure recommended by the makers for the type of aircraft concerned). The system can be operated by one man, since pumping is remotely controlled by the opening and closing of the discharge nozzle. The pipeline incorporates a "pressure alleviator"—essentially a bag filled with nitrogen—to absorb the shock caused when the discharge valve is closed.

Notwithstanding the system's obvious advantages, the adoption of hydrant fuelling is likely to be a gradual process, and it is not foreseen as a replacement for mobile fuellers at all airports. The cost of equipping London Airport Central with a complete hydrant system would be in the region of £1m, and it seems that expenditure on this scale will not be possible until the future pattern of ground movements and parking has been established with reasonable finality. As a preparatory step, tarmac-filled channels will be incorporated in the new parking aprons at L.A.P., enabling pipelines to be laid without undue expense or delay. The short-haul "south-east face" area, however, is already in use, and it would be difficult to find a way of installing a hydrant system without disrupting present traffic arrangements.

A 12,000-gal tank at Eastleigh (upper view) supplies seven hydrants on the apron area, one of which is seen in use.

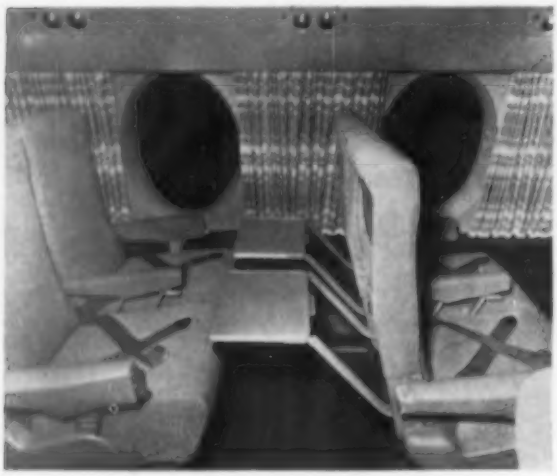
The flagship of the airline's fleet of 60 Viscounts is handsomely styled in white, scarlet and silver; note the Viscount "trademark" on the tail. This aircraft is fitted with 40 four-abreast seats (below) but Capital's standard layout will probably feature 44 or 48 seats. As in T.C.A.'s Viscounts, the chairs (below, left) are of Aerotherm manufacture but differ in that folding tables are provided.

CIVIL AVIATION . . .

CAPITAL TAKE DELIVERY

SOME 400 guests attended the handing-over ceremony held at Wisley on May 17th to mark the completion of the first of 60 Viscounts for Capital Airlines. Among them was the American Ambassador, Mr. Winthrop W. Aldrich, who said that there was no greater contributory factor to enduring Anglo-American relations than sound, mutually advantageous trade between the two countries. The $67m (nearly £24m) Capital order, largest single dollar sale by a British firm since the war, was a tribute to British salesmanship as well as craftsmanship—and to "Yankee" appreciation of a good deal.

Mr. J. H. Carmichael, president of Capital Airlines, said that his company selected the aircraft because it was the best one for their purpose. Handing over the Viscount, Lt.-Gen. Sir Ronald Weeks, chairman of Vickers, Ltd., reminded the audience of the significance of this Anglo-American occasion; these aircraft would be the first British airliners to fly on all-American routes.



As reported in *Flight* last week, Mr. George Edwards, managing director of Vickers-Armstrongs Aircraft Division, revealed that Viscount sales exceeded the 200 aircraft for which contracts had been publicly announced.

Souvenirs of the occasion were presented to the Ambassador and to Mr. and Mrs. Carmichael by Maj.-Gen. C. A. L. Dunphie, chairman and managing director of Vickers-Armstrongs, Ltd. Mr. Aldrich's memento took the form of a model Viscount in the attractive colour-scheme of Capital Airlines—as displayed at Wisley by Capital Viscount N7402.

All Capital's Viscounts are to be built at Hurn. The first aircraft is now completing flight trials and will be ferried to Washington within the next two weeks; two more aircraft are almost ready to fly and will follow soon after. Regular operations, based on this small initial fleet, are due to begin not later than August 1st (on the Washington-Chicago route). Deliveries will be resumed next September, continuing at an average of better than three per month until the 60th aircraft is handed over in February 1957.

BREVITIES

AN order from Bahamas Helicopters, Ltd., for two Westland S-55s and spares brings to 15 the number of these helicopters ordered for commercial use from the Yeovil factory. To be equipped with seats for nine passengers, and with floats for sea landings when required, the aircraft will be delivered in June and July. Based at Nassau, Bahamas Helicopters now operate a fleet of 18 American machines and are thus among the world's largest commercial operators of rotary-wing aircraft.

* * *

Silver City Airways expect to carry 55,000 vehicles across the Channel this year, compared with 42,000 in 1954. Last Saturday the airline made its 50,000th air crossing of the English Channel since the ferry began in July 1948.

* * *

The new firm of Fison-Airwork operated their first passenger service on May 13th. The flight, by Hiller 360, was chartered by Mr. Billy Butlin, the holiday camp owner, who flew from the South Bank, London, to Bolton, Lancashire, to open a new sports pavilion.

* * *

A new record for the 1,415-mile Perth-Adelaide route was set up on May 11th by T.A.A. Viscount VH-TVE, which, assisted by a 30 m.p.h. tailwind, covered the distance at an average ground speed of 350 m.p.h. The Viscount took 3 hr 57 min for its journey; the previous record, held by a DC-6 of A.N.A., was 3 hr 59 min.

* * *

B.O.A.C., in association with the Navigators' and General Insurance Co., Ltd., announce the introduction of an emergency travel insurance scheme whereby British subjects overseas can indemnify themselves against the cost of emergency visits to sick relatives in the United Kingdom or other parts of the world. The scheme, which covers incidental travel and hotel costs as well as the air fare, also permits relatives to visit policy holders should they become ill while overseas.

* * *

Civil Aviation Information Circular No. 50/1955 draws pilots' attention to the fact that Manston is not a Customs airport; Customs facilities there are restricted to clearance of scheduled services forced to use Manston as a "supplementary aerodrome". The Air Ministry Meteorological Office is prepared to offer two-week courses for controllers employed at non-state airports to train them in the preparation of weather reports; details are given in *Circular No. 51/1955*.

Everyone used to — a long time ago. It was then, as soon as aluminium took to the air, that T.I. Aluminium Alloys began to serve the British aircraft industry. Now, when the momentum of development has never been fiercer, these alloys continue to keep pace — and faith — with the men who pit their brains against tomorrow; with the designers, the manufacturers, the pilots; with all those who put aluminium first, and T.I. in front of it.

40TH ANNIVERSARY

T.I. Aluminium Ltd. offer their compliments and congratulations to Gloster Aircraft and think with pleasure of their long association with so historic a company

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PROBLEMS OF FLIGHT

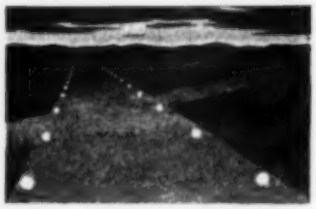
LIGHTS AND BEACONS

Night-flying is full of difficulties. Navigation apart, the risk of collision apart, there is the difficulty of identifying the runway from the air, and the difficulty of identifying an incoming aircraft from the ground.

The problem has been solved partly by the use of lights. Aircraft carry navigation lights; airfields are identified by lights; runways are defined by lights. A simple and logical solution — and one devised by Nature for many of her creatures in the early youth of life on this planet.

Luminescence in living creatures is widespread. (Even some plants are luminous — bacteria in rotting fish and fungi in dead wood.) The most striking examples in the animal kingdom are glow-worms, deep-sea fish, and phosphorescent creatures of the sea's surface. Their light occupies the whole visible spectrum, without infra-red or ultra violet. It is produced by the oxidation of various chemically-complex substances made in specially-developed cells.

Why? In the case of bacteria one twenty-five-thousandth of an inch in diameter, luminescence is probably an accidental by-product of some organic process. In the luminous protozoa, minute star-fish, and other drifting surface creatures, there may be a reason for the light — but we do not know it. Of the creatures who live in the perpetual darkness of the deepest seas, some probably use



light to see by, some to repel enemies, some to attract prey But this is guesswork.

Only in glow-worms is the reason clear. These flashing, dancing miniature beacons use their light-signals to attract and identify each other. (An expert can tell the kind of glow-worm — there are many species — from the length of the flashes and the intervals between them.) Exactly-timed, unmistakably recognizable, the glow-worm's light is a perfect way of announcing his identity and whereabouts.

Man, in his recent invention of aircraft navigation lights and airfield identification lights, has borrowed yet another of Nature's ancient devices.

Pilots who land by night or day at airfields all over Britain have come to value the excellent and helpful service of the Shell and BP Aviation Service.

SHELL and BP AVIATION SERVICE

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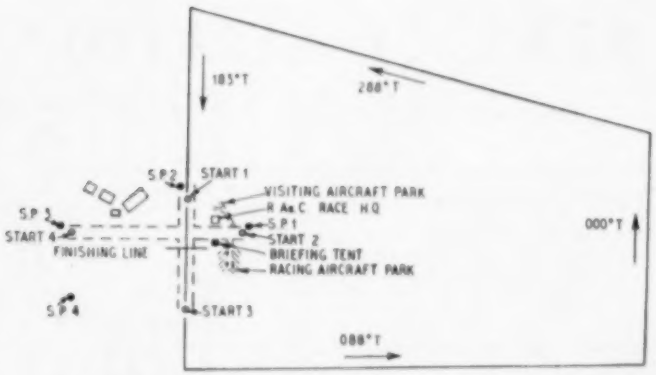
Distributors in the United Kingdom for the Shell, BP and Eagle Groups.

National Air Races—Round 2

Racing and Display at Yeadon



The Yeadon 7.5-mile circuit and runways (not strictly to scale). S.P.=scatter point.

No.	Entrant	Pilot	Aircraft	Engine(s)	Reg.	Pts.*
S.B.A.C. Cup (aircraft exceeding 160 m.p.h.)						
92	G. C. Marler	Entrant	Falcon Six	Gipsy Six	G-ADTD	14
96	R. R. Paine	Entrant	Hawk Sp. Six	Gipsy Six 1F	G-ADGP	13
97	F. Dunkerley	—	Mew Gull	Gipsy Six 2	G-AEXF	—
98	F. Dunkerley	Entrant	Sparrowjet	2 Palas	G-ADNL	13
Goodyear Trophy (Miles Geminis)						
80	P. Blamire	Entrant	Gemini 1a	2 Cirrus Mi. 2	G-ALZG	14
84	F. Dunkerley	Entrant	Gemini 1a	2 Cirrus Mi. 2	G-AKKB	13
85	J. N. Somers	Entrant	Gemini 2	Gipsy Maj. 1c	G-AKDC	12
Air League Cup (Percival Proctors)						
66	W. Reeks and G. Hugh	V. Edwards	Proctor 1	Gipsy Queen 2	G-AHFU	—
67	E. Noel Husbands	Entrant	Proctor 1	Gipsy Queen 2	G-AIHG	13
68	E. Crabtree	R. K. Roberts	Proctor 3	Gipsy Queen 2	G-ANWY	—
69	T. G. Knox	Entrant	Proctor 3	Gipsy Queen 2	G-ALCK	16
Kemsley Trophy (aircraft exceeding 130 m.p.h. and not eligible for S.B.A.C. or Air League Cup)						
40	A. J. Spiller	Entrant	Messenger 2a	Cirrus Maj. 3	G-AKIN	12
41	A. J. Linnell	D. F. Ogilvy	Comper Swift	Pobjoy "R"	G-ABUS	11
43	J. R. Johnston	Entrant	Hawk Tr. 3	Gipsy Maj. 1	G-AJRT	10
45	C. G. Wheatley	Entrant	Globe Swift	Continental C-125	G-AHWH	9
47	J. N. Somers	Entrant	Chipmunk	Gipsy Maj. 10	G-AKDN	18
48	Cartwright Hamilton Aviation Ltd.	R. Dunster	Hawk Major	Gipsy Maj. 1c	G-ADWT	—
Norton-Griffiths Trophy (Tiger Moths)						
21	N. Jones	B. Maile	Tiger Moth	Gipsy Maj. 1	G-ANSX	16
22	P. Vanneck	Entrant	Tiger Moth	Gipsy Maj. 1	G-ANOD	6
23	J. H. Denyer	Entrant	Tiger Moth	Gipsy Maj. 1	G-AIVW	18
24	J. M. Donald	Entrant	Tiger Moth	Gipsy Maj. 1	G-AMTK	9
25	N. Jones	B. J. Snook	Tiger Moth	Gipsy Maj. 1	G-ANZY	12
Grosvenor Cup (aircraft up to 130 m.p.h., excluding Tiger Moths						
4	Yeadon A.C.	J. Grummett	J.5 Autocrat	Cirrus Minor 2	G-AJAS	—
5	C. Gregory	Entrant	Taylorcraft Plus D	Cirrus 1	G-AHGZ	14
8	Yorkshire Aeroplane Club	J. F. Morgan	J.5 Autocrat	Cirrus Minor 2	G-AJUD	—
9	J. K. O'N. Edwards	D. Westoby	Aiglet J.5K	Cirrus Major 3	G-AMMS	13
10	J. E. Appleyard	Entrant	Chilton D.W. 1a	Train D4T	G-AFSV	—

*Total British Air Racing Championship points after first meeting.

THE second round of the 1955 series of National Air Races is to take place at Yeadon Airfield, near Leeds, on Whit Monday, May 30th. There will be six class-races, for which there are 27 entries. This meeting will comprise the second of a series of four races for each of the six trophies, the first having been flown at Swansea on April 30th. Eligibility for participation in the King's Cup Race at Baginton, Coventry, on August 20th, will be decided from the results of the whole series.

The six races at Yeadon will be interspersed among the events of the flying display, which, starting at 2 o'clock, will include two parachute jumping events, U.S.A.F. Thunderjets, a Canberra, a Hunter, and other items. The races will take place as follows:—

2.00 The Goodyear Trophy race (Miles Geminis).
2.45 The Norton-Griffiths Trophy race (Tiger Moths).
3.45 The S.B.A.C. Cup race (aircraft, except Miles Geminis and Percival Proctors, with a maximum speed exceeding 160 m.p.h.).
4.10 The Air League Cup race (Proctors).
5.00 The Kemsley Trophy race (aircraft with a maximum speed exceeding 130 m.p.h., not eligible for the S.B.A.C., Goodyear or Air League class races).
5.30 The Grosvenor Cup race (Austers and aircraft other than Tiger Moths with a maximum speed below 130 m.p.h.).

Each race will be flown over a four-sided course with a lap distance of 7.5 miles. The Air League, S.B.A.C., Goodyear and Kemsley races will be over four laps, a total distance of 30 miles, and the other two events over three laps, or 22.5 miles. Wind direction permitting, the start will be on the north-south runway, directly on course, and the finishing line will lie across the final north-south leg. The individual legs of each lap measure 1.9, 2.3, 1.0 and 2.3 miles.

Yeadon Airfield lies six nautical miles north-west of Leeds and visiting aircraft should use only the tarmac runways. V.H.F./D.F. and R/T. facilities will be available on 122.3 Mc/s, as well as meteorological forecasts. The airfield's telephone number is Rawdon 1187. The air display will be under the auspices of the Soldiers', Sailors' and Airmen's Families Association.

Admission for adults is 2s 6d, and for children 1s 6d; parking for cars and coaches is 5s and for motor cycles 2s 6d. Special services are to be provided by the public-transport companies.

CLUB AND GLIDING NEWS

WITH the help of the Vickers-Armstrongs Flying Club, the Fair Oaks Aero Club logged a record total of 501 paid flying hours for the month of April. Messrs. Sowrey and Chidale, and Cadets Howells, Edmunds, Osborne and Curtin obtained P.P.L.s, while first solos were successfully made by Messrs. Tice, Proctor, Bower, Brown, Smith and Cadet Sharman.

Sunday, July 3rd, has been selected for the At Home to be organized jointly by the Fair Oaks Club and the London Transport Flying Club.

Mr. L. R. Snook (Portsmouth Aero Club), with S/L. A. Mitchell, recently took delivery of the first British-registered Beech Bonanza G-AOAM (previously Aden-registered VR-ABA), from Mr. Alex Duncan of R. K. Dundas, Ltd., who are importing a batch of these aircraft.

THE Aero Club of Ireland's 1955 air display and rally at Weston Aerodrome, Leixlip, near Dublin, will be opened on Sunday next, May 29th, by the Minister for Industry and Commerce, Mr. Norton, who is the Minister responsible for civil aviation in Eire. A full and varied flying programme has been arranged for both Sunday and Monday, including demonstrations by Aer Lingus and the Irish Air Corps.

YORKSHIRE Aeroplane Club is "At Home" on Sunday, June 26th to members of all other flying clubs. A flying display, including a bombing competition, is on the programme. During April the club logged 210 flying hours; first solos were made by Cadets Booth, Tabberer, Upton and Radford; and Mr. Bernard Hazlewood obtained his P.P.L.

A THIRD flying instructor, Eric Pope, has joined the staff of the Denham Flying Club. In view of the increase in membership, an additional Auster is shortly to be acquired, bringing the club fleet up to six.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Joint Experimental Helicopter Unit

UNDER the command of Lt.-Col. J. F. T. Scott, T.D., R.A., the Joint Experimental Helicopter Unit started operations at Middle Wallop on April 1st. The unit's official rôle is to collect information by practical trials to enable the Army and the R.A.F. to determine whether helicopters, "or such other aircraft as may be allotted to the unit" (a reference to V.T.O. aircraft), are likely to be a practical, efficient and economical means of solving the Army's future problems of mobility, organization and administration in the field. This may include problems which are shared with other Services in forward areas.

More simply, the Army is seeking a device having all the advantages of being airborne and yet requiring nothing more than a level field as a base. In the same way that in the 1914-18 war horse-limbers and cavalry gave place to motor lorries and tanks, so the Army is now searching for suitable aircraft to take the place—where conditions justify—of motor transport and to add aeronautics as a further step in the mechanization of its fighting troops.

As initial equipment the unit has only two Bristol Sycamores, which, until delivery of larger types takes place, will have to simulate heavy-load-carrying helicopters. Six machines are hoped for during the first year of operation with, perhaps, the establishment of a second flight in June 1956. It is thought that, in addition to straightforward helicopters or V.T.O. aircraft, fixed-wing aircraft with exceptional take-off and landing characteristics might also be tried by the unit. Participation in manœuvres is expected in about two years' time.

Having had much practical experience in Korea, the Americans are considerably more advanced than we are in the operation of helicopters in front-line conditions. They are putting their accumulated experience at the disposal of the unit, liaison being carried on through the British Joint Services Mission.

The Joint Experimental Helicopter Unit is at present made up of personnel from the Army and the R.A.F. in equal numbers. No scheme for ultimate control of the flying side of the Army has yet been formulated. The unit is now run in a fashion identical with that of an A.O.P. squadron, but doubtless the time will come when the Army will endeavour to gain complete control of its own air services.

Sculptor Adam Bienkowski at work on the badge of No. 19 Squadron, one of the 900 which will decorate the church of St. Clement Danes, now being rebuilt as the Royal Air Force church. The badges seen here are those of Nos. 63, 39, 53, 54, 26, 21, 25, 36 and 37 Squadrons.

Second in command to Lt.-Col. Scott is S/L. D. C. L. Kearns, A.F.C., R.A.F., and the Flight Commander, Major J. B. Spittal, R.A., has under him four Army pilots, all seconded from the Royal Army Service Corps and two R.A.F. pilots. The pilots without helicopter experience are attending a 30-hour conversion course at Westlands and Bristols.

No. 45 Squadron, R.F.C., Dinner

FORTY members of the original No. 45 Squadron, Royal Flying Corps, which fought in France and Italy during the 1916 to 1918 period, dined in London with ten guests on the evening of May 7th. Every year since about 1925—except for the period of the Second World War—members of the old Sopwith 1½-Strutter and Camel squadron have met as friends on the evening of the Football Cup Tie Final, coming from as far afield as Scotland, Lancashire and Cornwall. Major J. A. Crook, who commanded the unit in Italy and France from July 27th to October 20th, 1918, was in the chair on this occasion.

The guest of honour was the Vice-Chief of the Air Staff, Air Chief Marshal Sir Ronald Ivelaw-Chapman, who won his D.F.C. when flying in "Big Ack-Ws" with No. 10 Squadron in the First World War. Giving the toast of "The Guests," Capt. Norman Macmillan, who won his Military Cross with No. 45 Squadron, referred to Sir Ronald's work with No. 10 Squadron, and recalled how he won the A.F.C. by his outstanding work during the evacuation of civilians from Afghanistan during the world's first airlift rescue operation. During the operation he made an astonishing forced landing on a narrow ledge in the mountains, and without casualties.

Capt. Macmillan also welcomed a past C.O. of the present No. 45 Squadron, S/L. I. R. Stockwell, and several other members of the unit, which is now flying Hornets in Malaya.

Replying for the guests, Sir Ronald Ivelaw-Chapman said it gave him great pleasure to be present at this reunion, yet at the same time it made him feel rather ashamed that his own old squadron did not meet in the same way. He felt that the success of the 45 reunion was due to its having been organized from the beginning "by the men of the squadron for the men," with as many officers as possible joining in, rather than as an officers' dinner. He was proud to be there; but he was not one who subscribed to the view that the young men of today were not every bit as sound, patriotic and gallant as the men who sat around the table had been in their youth.

After dinner a film of the presentation of its Standard to No. 45 Squadron in Malaya was shown by S/L. Stockwell.

Next year the reunion will celebrate the 40th anniversary of the founding of the squadron; past or present members are invited to communicate with Mr. B. Wetherall, 154, Princes Road, Buckhurst Hill, Essex, so that their names may be added to those already known to him for advice of the 1956 Reunion.

The commanding officer, adjutant and some of the pilots of the Joint Experimental Helicopter Unit (see above): Capt. D. S. Woolas, Adj., F/L. B. M. Ridgway, Lt.-Col. J. F. T. Scott, C.O., S/L. D. C. L. Kearns and Maj. J. B. Spittal. "Flight" photograph

McKee Trophy

WINNER of the McKee Trans-Canada Trophy for 1954 is W/C. J. G. Wright, D.F.C., head of the Instrument Development Section at R.C.A.F. headquarters, Ottawa, Ontario. He won the award for his invention of the R.Theta computer. The McKee Trophy, which dates back to 1927, is presented for meritorious services in advancement of Canadian aviation.

The R.Theta computor gives the pilot of an aircraft the direction to steer and distance to go to any position he sets on the instrument.

New Zealand S.A.S.

MORE than 600 men have volunteered for service with the Special Air Service Squadron which New Zealand is sending to Malaya. The volunteers comprise some 150 from the Regular Force, and the remainder from outside the Army. The total of volunteers is nearly three times as many as the special force will require.

Congratulations to Gloster

makers of the first jet aircraft

on their 40th Anniversary

Rotax are proud to have supplied turbo and electrical starters, generators, actuators, switchgear, invertors and lighting for many of the Gloster aircraft.

We look forward to the continuance of our long associations with Gloster.

ROTAX *for complete Electrical and Starting Systems for Aircraft.*

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It's a far cry . . . in fighters or fuelling

More and more revolutionary become the modern military aircraft of Britain—and in most cases only one thing remains constant—*quality*. Otherwise the modern Gloster Javelin fighter, most recent of a long line of famous fighting aircraft, bears very little resemblance to its predecessor of forty years ago. And as aircraft performances improve, so have the auxiliary services on the ground. Because of this,

Avery-Hardoll Pressure Refuelling Equipment

is widely used to carry out fuelling and defuelling *with the utmost speed and safety*. With negligible fuel spillage, Avery-Hardoll couplings make connections much faster and simpler, combining high rates of flow with low pressure loss.

A combined access door and sealing cap saves weight and provides a flush skin finish. Another unit designed and manufactured by:

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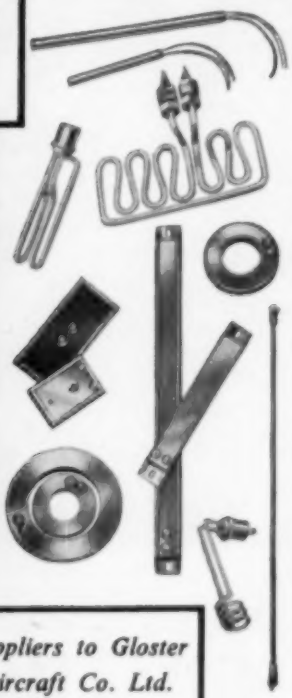

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The **Model 7** Universal

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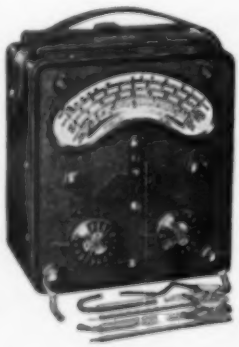

The world's most widely used combination electrical measuring instrument. Provides 50 ranges of readings on a 5-inch hand-calibrated scale fitted with an anti-parallax mirror. Guaranteed accurate on D.C. and A.C. up to 2 Kc/s to the limits laid down in B.S.S. 98/1954 for 5-inch scale-length industrial portable instruments.

The meter will differentiate between A.C. and D.C. supply, the switching being electrically interlocked. The total resistance of the meter is 500,000 ohms.

CURRENT: A.C. and D.C. 0 to 10 amps.

VOLTAGE: A.C. and D.C. 0 to 1,000 volts.

RESISTANCE: Up to 40 megohms.

CAPACITY: 01 to 20 μF.

AUDIO FREQUENCY POWER OUTPUT: 0+2 watts.

DECIBELS: −25Db. to +16Db.

The instrument is self-contained, compact and portable, simple to operate and almost impossible to damage electrically. It is protected by an automatic cut-out against damage through severe overload.

Various accessories are available for extending the wide ranges of measurements quoted above.

£19 : 10s.
Size: 8 in. × 7½ in. × 4 in.
Weight: 6½ lbs. *(including leads)*

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A7/6

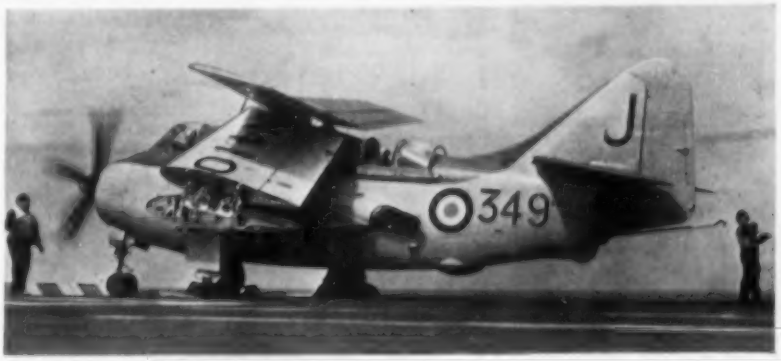
BROOD of the EAGLE

(Continued from page 711)

827 Sqn., and there was no doubting the sincerity of their enthusiasm for their aircraft. The Sea Hawks and Skyraiders are, of course, well established and thoroughly popular with all hands; and we have it on the authority of Lt. Hort, of the Helicopter Flight, that the Dragonflies are giving exemplary service.

As for *Eagle* herself, she remained rock-steady when lesser craft passed by dipping and reeling. Her vast island structure, on the starboard side, is said to be as large as a frigate, and houses, among other mysterious quarters and installations, the operations room, under the direction of Lt-Cdr. "Freddie" Holmes. The two hangars, we were assured, could accommodate 263 double-decker buses. Armament is dual-purpose, comprising sixteen 4.5in guns in twin HA/LA turrets, and numerous multiple and single 40 mm Bofors. The 4.5s are grouped in four batteries and are capable of engaging targets travelling at very high speeds. Radar control enables targets to be engaged at night or in low visibility with accuracy corresponding to that achieved in visual fire.

The latest Wyverns, as represented by the furthest machine in this group of No. 827 Sqn., do not have folding wing-tips. Spotted at the corner of the deck are two Skyraiders of No. 849 Sqn.



"Eagle's" identifying letter "J" is painted on the tails of her aircraft, as on this Gannet.

"Flight" photographs

The Sea Hawks, one of which is seen above well and truly hooked, function as intercepters and as strike aircraft. At upper right, one of "Eagle's" Dragonfly HAR.3s comes aboard after a morning's vigilance. On the right, six Sea Hawks are spotted to port, with a Wyvern taxying in the foreground.

THE INDUSTRY

Maj. H. Hemming Returns to Aviation

AS briefly mentioned in our issue of April 29th, Maj. H. Hemming, A.F.C., F.R.Ae.S., has rejoined the aircraft industry, in which he was well known before the war, particularly in connection with air survey. He returns as chief liaison officer to Burnley Aircraft Products, Ltd., specialists in gas-turbine "hot parts." After service in the R.F.C. and R.A.F. in the First World War—near the end of which he was engaged in pioneer blind-flying experiments and was subsequently chief instructor and assistant commandant of No. 1 School of Navigation and Bombing, Stonehenge—Maj. Hemming turned his attention to the possibilities of long-distance air routes. He helped to form the Bermuda and West Atlantic Aviation Co., Ltd., and was appointed joint managing director. In 1923, at a period when he was competing regularly as a racing pilot, he was appointed managing director of the Aircraft Operating Co., Ltd., of which he was a founder.

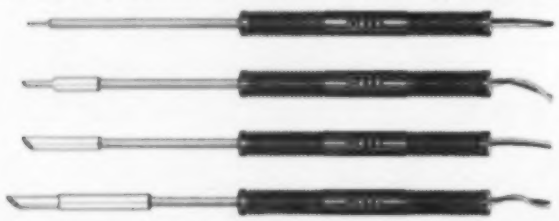
Maj. H. Hemming

Ten years later—having, in the intervening period, carried through numerous noteworthy air survey operations in many different parts of the world—he formed H. Hemming and Partners, Ltd. In due course this company acquired control of the Aircraft Operating Co., and of Aerofilms, Ltd., and took a leading place among the world's air-survey operators.

In World War Two the company's staff formed the nucleus of the R.A.F. Photographic Interpretation Unit (later to become the Central Interpretation Unit), which Maj. Hemming commanded, with the rank of acting wing commander. Later he was engaged on flying-control duties, and after the war he helped to finance the formation of the Pathfinder Association. During the past eight years he has been occupied with a fishing hotel in Western Ireland. Maj. Hemming may be contacted at the Royal Aero Club or at his private address, 22 Kensington Park Gardens, London, W.11.

Precision Soldering

DESIGNED for work on electronic assemblies and instrument movements and in similar situations, the Oryx miniature soldering instruments illustrated here are designed to operate on voltages ranging between 6 and 50. Among advantages claimed—



Four of the five standard types of Oryx soldering instrument, shown at about half their actual size. Model numbers, reading downwards, are 6, 6A, 9 and 12.

and which we can confirm by test—are absence of fatigue in use, quick (30 sec) heating-up, and simple, robust construction. Details of the complete range are as follows:—

Model	Consumption (watts)	Voltage	Bit diameter (mm.)	Weight (oz)	Length (in)	Price
12	12	6, 12, 24 or 50	4.8	0.5	6½	£1 5s.
11*	10	6	4	0.5	6	£1 15s.
9	8.3	6, 12 or 24	4	0.25	6	£1 5s.
6A	6	6	2.4	0.25	6	£1 5s.
6	6	6	1.6†	0.25	6	£1 5s.

* High-temperature model. † Fixed bit.

Sole distributors of Oryx miniature soldering equipment are Antex, Ltd., of 3 Tower Hill, London, E.C.3.

Mr. Wright

Mr. Hack

Bristol Appointments

A JOINT announcement by the Bristol Aeroplane Co., Ltd., and the Asquith Machine Tool Corporation, Ltd., states that Mr. George Wright, general manager of the Bristol engine division since January 1952 is being released from his appointment, on August 31st, in order to accept a position as an executive director of the Asquith Corporation and certain of its subsidiary companies.

Bristols also state that Mr. George Hack, at present assistant general manager of the engine division, will succeed Mr. Wright as general manager of the division and has been appointed a member of the divisional management Board.

Mr. Wright joined Bristols as a jig and tool designer in 1930 and, after a period during which he was with a firm in Sheffield, rejoined them in 1935. From 1941-45 he was manager of the Hawthorn shadow factory and subsequently took charge of all the company's factories in the north of England. He returned to Bristol in 1947 as works manager of the engine factory and was appointed general manager of the engine division in 1952.

Mr. Hack has been assistant general manager of the engine division since 1951. Well known in pre-war days as a metallurgist and as manager of the Rudge-Whitworth motor-cycle racing team, he joined the Bristol engine division in 1939 and, after managing various Bristol factories, was engaged on post-war reorganization of the engine division. In 1947 he was appointed manager of the Rodney Works and took up his present post in 1951.

Another Bristol appointment announced last week was that of Mr. James McOran Campbell as senior technical representative in Pakistan in succession to Mr. Noel Holman, whose four-year tour of duty ends in July. In pre-war years Mr. Campbell was with de Havillands and Imperial Airways, and during the war flew as an A.T.A. pilot, later becoming a Hawker production flight development engineer and test pilot. He joined the Bristol engine division in 1951.

IN BRIEF

Mr. A. R. Collie, formerly assistant sub-contracts officer of Westland Aircraft, Ltd., has been appointed sub-contracts officer in succession to Mr. J. Wood, who has left the company.

* * *

C. C. Wakefield and Co., Ltd., announce the appointment of Mr. Leonard Colkett as secretary to the company. He joined the firm in 1934, and has served in the secretarial department since.

* * *

Negotiations which have been taking place during recent months between Dunlop and certain Spanish interests have reached an advanced stage, and the establishment of a tyre factory at Bilbao is likely to materialize in the near future.

* * *

Mr. J. R. Duff, A.M.I.Mech.E., has been appointed works manager of Blackburn (Dumbarton), Ltd., in succession to Mr. L. Maxwell, who has left the company. An engineer officer in the Royal Navy during the war, he was recalled by the Admiralty in 1950 for development on the Napier "Deltic" marine engine; and prior to joining Blackburn (Dumbarton), Ltd., he was works director of Porn and Dunwoody in London.

* * *

The appointment of Mr. A. W. E. Houghton as a special director of Vickers-Armstrongs, Ltd., has been announced. His duties as assistant general manager (production) of the aircraft division include responsibility for all production, including that of guided weapons, at the Vickers-Armstrongs factories at Weybridge and Hurn. Mr. Houghton will also retain his divisional responsibilities for experimental work.

* * *

Airtech, Ltd., of Aylesbury and Thame Airport, Haddenham, Bucks, have recently negotiated a contract with the Canadian Department of Defence Production, providing for the maintenance, overhaul and repair of all electronic equipment used by the Royal Canadian Air Force in the U.K. The company has been overhauling the electrical equipment used on R.C.A.F. Sabres for some years past, and this work has now been extended to cover V.H.F., radio compass, I.F.F. and other electronic equipment.

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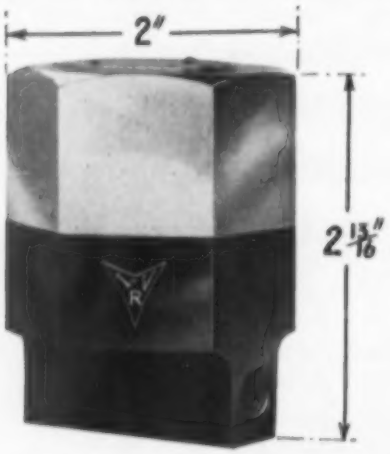

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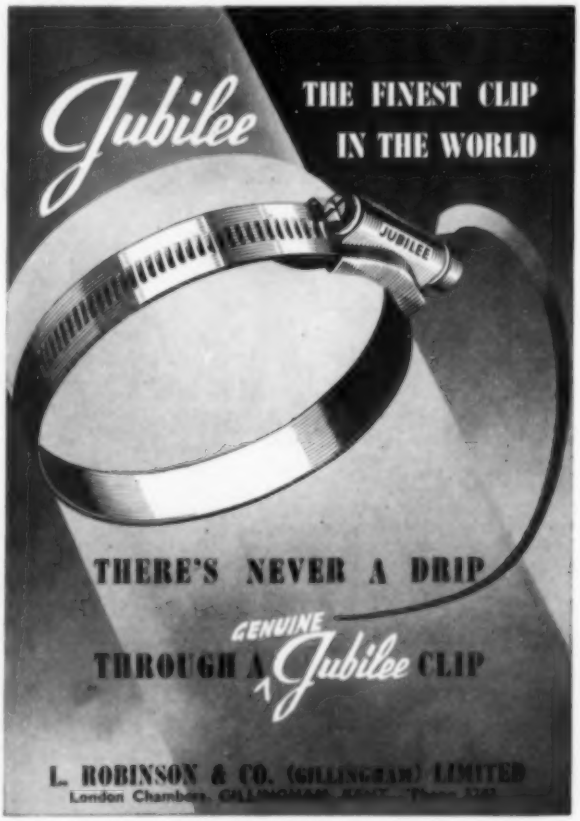

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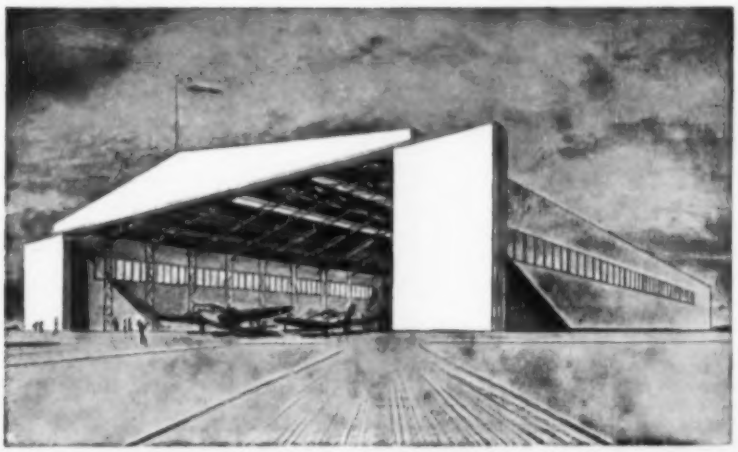

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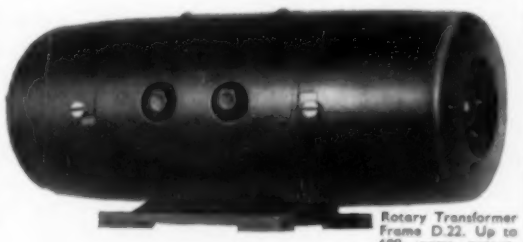

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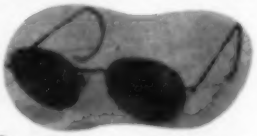

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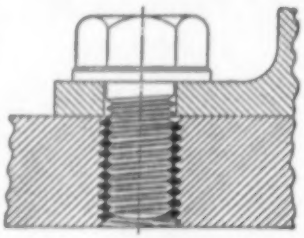

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APPLICATION No. 131/1. From Lancashire Aircraft Corporation, Ltd., of 7, Berkeley Street, London, W.1, for permission to increase the frequency up to 24 services daily, on their U.K. Internal Service on the route Blackpool (Squires Gate)—Isle of Man (Ronaldsway) which they are approved to operate for the period up to 31st December, 1959.

APPLICATION No. 479. From British European Airways Corporation, of Keyline House, Ruislip, Middlesex, for a Normal Scheduled Service with Viscount and Elizabethan aircraft for the carriage of passengers, supplementary freight and mail between London Airport and Valencia with an optional intermediate traffic stop at Biarritz at a frequency of four services weekly increasing further according to traffic demand for a period of 10 years commencing 1st April, 1956.

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Good opportunities

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THE PERSONNEL OFFICER

PUBLIC ANNOUNCEMENTS

UNIVERSITY OF CAMBRIDGE

DEPARTMENT OF ENGINEERING

Post-Graduate Course in Structures and Materials

A POST-GRADUATE course in Theory of Structures and Strength of Materials, extending over one year (October to June) will begin at the Department of Engineering, Cambridge University, on October 5th, 1955.

THE latest advances made in the understanding of the behaviour of metallic structures under static, repeated or fatigue loading will be the principal subject of the course, with particular emphasis on welding as a method of fabrication. No attempt will be made to teach conventional methods of design, but present-day practice and possible future developments will form the subject of critical study.

THE object of the course is not to train research workers, but to help engineers to apply the latest advances in knowledge. The course will include lectures, colloquia and laboratory work, and each student will be encouraged to make a detailed study of some problem of particular interest to him.

THE course is open to university graduates with industrial experience, and to others with suitable equivalent qualifications.

APPLICATIONS for admission should be sent by July 31st to The Secretary, Cambridge University Engineering Laboratory, Trumpington Street, Cambridge, from whom further particulars may be obtained. [3778

PUBLIC APPOINTMENTS

COMMONWEALTH OF AUSTRALIA

Department of Supply

Aeronautical Research Laboratories

Fishermen's Bend, Victoria

APPLICATIONS are invited for a temporary (equivalent to "unestablished") position of Scientific Officer, Grade 3, at the above Laboratories.

SALARY: £1,604/1,730 per annum.

DUTIES: Under direction to work on the aerodynamic development and research relating to new types of aircraft and missiles, and on general problems in low speed aerodynamics.

QUALIFICATIONS: University degree of high standard in Aeronautical Engineering or equivalent qualifications. Several years' experience in wind tunnel investigations related to the aerodynamic development of aircraft missiles.

THE salaries quoted are Australian currency.

UNDER specified conditions, first class boat fare (if first class berth available) of the appointee and dependants (wife and dependent children) will be paid by the Commonwealth. The A.R.L. Housing Society may assist the appointee with house purchase.

APPLICATION forms obtainable from:

SENIOR REPRESENTATIVE (AP.26),
Department of Supply,
Australia House,
Strand,
London, W.C.2.

with whom applications should be lodged by 18-6-55. [3783

MINISTRY OF SUPPLY invites applications for appointment to outstation of Royal Aircraft Establishment located near Woodbridge, Suffolk, to work on problems of all-weather landing of aircraft. Duties involve design and assessment of full-scale flight experiments in blind approach and landing, and liaison with appropriate Civilian and Service Authorities. Appointments graded according to qualifications, experience, etc. Scientific Officer—Quals.—1st or 2nd Class Hons. degree or equivalent in physics, mathematics or engineering. Experimental Officer (min. age 26) minimum qualification Higher School Cert. (science) or equivalent. Salary range—S.O.—£467 10s. —£845 (Superannuable). E.O.—£715—£880. Women somewhat less. Some experience in electronics or aerodynamics would be useful for all posts. Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting A 165/5A. [3772

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The design office is at present engaged upon a new civil aircraft and additional staff are required with the following experience at Southend-on-Sea.

Aircraft Structures
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Phone: Ealing 8949. [0249

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FOR details of these and other courses, apply to:—The Commandant, Air Service Training, Ltd., Hamble, Southampton. [0970

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SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

PILOTS required for overseas service. Minimum requirements Commercial and I.R. Liberal pay and allowances. Accommodation found. Morton Air Services, Ltd. CRO. 7171. [3757

MIDLAND Aircraft firm has vacancies for capable Designer-Draughtsmen and Stressmen. If you have good qualifications and experience and are already earning at least £900 p.a., please send full details to Box 3773. [3696

A. & C. Licensed Engineer with Marathon/Dove and Gipsy Queen Series 70 Endorsement required for service in Europe with effect from the 1st of June.—Write or telephone Airwork Limited, Overseas Division, Sutton Lane, Langley, Bucks, Langley 520. [3719

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EXPERIENCED radio officers required immediately. Applicants must hold M.T.C.A. 1st Class Flight Radio Operators licence (temporary licence acceptable). Salary according to experience in scale £725—£1,140 p.a. Good allowances.

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BOVINGDON—all grades.
STANSTEAD—grades shown in section 6.

INTERESTING work on Hermes aircraft with good rates of pay and conditions.
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SKYWAYS, LTD.,
Bovingdon Airport,
Herts.
For AIRCREW and STANSTEAD—
Personnel Manager,
SKYWAYS, LTD.,
Stanstead Airport,
Essex. [3761

1ST Officers with Dakota endorsement required.—Apply Starways, Ltd., Liverpool Airport. [3720

DRAUGHTSMEN required, capable taking charge of various aircraft installations, projects, details experience, qualifications to Airwork, Gatwick Airport, Horley, Surrey. [3732

FLIGHT ENGINEERS

required, preferably with "A" and/or "C" licences on Tudor aircraft.

Apply by letter in first instance giving full particulars to :—

Operations Manager
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Consideration will also be given to Draughtsmen with Mechanical, Structural or Electrical experience.

Also

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(SENIOR & INTERMEDIATE)

for both strength and flutter calculations.

The conditions of employment are good with progressive salary, good sports and welfare facilities, pension scheme, etc.

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CHIEF DESIGNER

AERONAUTICAL RADIO SERVICES LTD.

VACANCIES

FOR

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Applications are invited from engineers conversant with Civil or Service aircraft equipments.

Applicants should have some experience in laboratory techniques, and the use of test equipment, as all work is governed by A.R.B. or A.I.D. specifications.

Consideration will be given to applicants with limited laboratory experience, where they have a wide experience of Radio Maintenance on aircraft.

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CAMBERLEY, SURREY

Telephone Camberley 2341

GUIDED WEAPONS TRIALS WORK

The Guided Weapons Department of The Bristol Aeroplane Co., Ltd. at Filton has vacancies for two categories of staff engaged in Guided Weapons Trials Field Work.

Applicants for the Senior Category are expected to have an Engineering Degree and practical experience, or an equivalent professional qualification with extensive engineering experience in industry or the Services.

Applicants for the less Senior Category are expected to have a Higher National Certificate in Engineering or the equivalent and some engineering experience.

The Duties are Administrative and Technical in nature, and provide great scope for exercising a sense of responsibility. They will involve living away from base for short periods with the possibility of short terms abroad.

Good salaries appropriate to experience and qualifications are offered. Serving Officers, who are about to terminate their engagements are invited to apply for the Higher Category, which offers an exceptionally good opening with long-term prospects.

Applications, giving details of experience, qualifications and age, quoting D.O.38, should be addressed to the **Personnel Manager, The Bristol Aeroplane Co., Ltd., Aircraft Division, Filton House, Bristol.**

SITUATIONS VACANT

ROYAL TECHNICAL COLLEGE, SALFORD.

Principal: P. F. R. Venables, Ph.D., B.Sc., F.R.I.C.

THE Governors invite applications for the following new teaching posts from suitably qualified candidates who should preferably have a professional qualification, university degree, or other equivalent qualification. Teaching experience is desirable and, where relevant, industrial, professional and/or research experience will be advantageous.

SENIOR LECTURER IN AERONAUTICAL ENGINEERING, mainly for teaching in College Associateship/Higher National Diploma Courses.

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ASSISTANT LECTURERS GRADE B, MECHANICAL ENGINEERING, for teaching Mechanical, Production or Aeronautical subjects—two posts.

ALL the foregoing appointments will date from September 1st, 1955, or as soon as possible thereafter. Salaries in accordance with the Burnham Technical Report 1954, namely:

Senior Lecturers, £1,065-£1,215 (men); £852-£972 + 1/7th differential (women).

Lecturers, £965-£1,065 (men); £722-£852 + 1/7th differential (women).

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Plus approved graduate and training allowances.

FOR further particulars and form of application please send a stamped addressed envelope to the Principal, Royal Technical College, Peel Park, Salford 5. Applications should be returned within 14 days of this advertisement.

R. RIBBLESDALE THORNTON,
Clerk to the Governors.
[3779

ROLLS-ROYCE LTD. (SCOTTISH FACTORIES)

are setting up a

Design and Development Organisation For Jet Engines

At their new factory in the town of East Kilbride which is approximately 8 miles from Glasgow. This is a new project which will provide unlimited opportunities in the future and there are immediate vacancies for the following positions:

Development & Technical Service Engineers

Engine development for improved performance and extension of service life. Applicants should be of degree or equivalent standard with National Service completed, and preferably some previous experience in this type of work.

Design Draughtsmen

Applicants should have minimum technical qualifications of H.N.C. and have experience of engine or accessory design.

Detail Draughtsmen

Applicants preferably with H.N.C. and previous experience on aero engine or accessory work.

Housing Accommodation will be supplied after a probationary period of three months, during which time Subsistence Allowance will be paid.

Applications marked TE/20, giving full particulars of previous experience, qualifications, and salary required, to the Personnel Manager, Rolls-Royce, Ltd., Hillington, Glasgow, S.W.2, after which arrangements will be made to interview suitable applicants in their own area. [3725

AERODYNAMICISTS, PHYSICISTS, MATHEMATICIANS & ENGINEERS

A RAPIDLY expanding aircraft instrument firm engaged on the design and development of autopilots for aircraft and helicopters has vacancies for the following:

(a) Stability and control analysis.
(b) Flight simulator assessment of aircraft stability.
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PREVIOUS experience in the aerodynamics or flight test department of aircraft or guided weapons industry desirable but not essential.

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METHODS Engineers required for the production and installation of electrical systems in the Britannia Aircraft.

APPLICANTS should be between 25 and 40 years and educated to H.N.C. standard or equivalent. A good knowledge of Aircraft Workshop practice is essential.

GOOD salaries and working conditions, together with the pension, life assurance and welfare schemes, make employment with this Company really worthwhile.

APPLICATIONS in writing should be addressed to the Personnel Manager, The Bristol Aeroplane Company Limited, Aircraft Division, Filton House, Bristol. [3751

WIND TUNNEL ENGINEERS FLIGHT TEST OBSERVERS AND DRAUGHTSMEN

The Bristol Aeroplane Company, at Filton, urgently require the following staff to carry out an extensive programme of research and development:

INTERMEDIATE and SENIOR WIND TUNNEL ENGINEERS

to staff the new sub-sonic and super-sonic wind tunnels. Applicants should possess either a degree or Higher National Certificate in aeronautical or mechanical engineering. Experience of wind tunnel work is essential for the senior positions.

INTERMEDIATE and SENIOR FLIGHT TEST OBSERVERS

to staff the Fixed Wing and Rotating Wing Sections of the Flight Research and Development Department.

Applicants should possess either a degree or Higher National Certificate in aeronautical or mechanical engineering, or a degree in physics or mathematics, and they should be interested in extensive flying during flight trials, and flight trial analysis.

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are required in both the Wind Tunnel Department and the Flight Research and Development Departments to undertake the interesting and varied model drawing instrumentation and structural work.

Good salaries are offered with prospects under excellent working conditions with extensive pension and welfare schemes.

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(Aircraft Division)

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LOUIS NEWMARK, LTD., have a vacancy in their laboratories for a Physicist or Electro-mechanical Engineer for development work on aircraft and allied instruments. Applications are invited from persons with a degree or similar qualifications who have had some industrial experience preferably on work with gyroscopes or accelerometers. Good salary and prospects. Apply Personnel Manager, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon, Surrey. [3776

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Posts 1 and 2 are for senior technicians and will carry good salaries and excellent prospects. The posts 3 do not necessarily require experience.

Assistance can be given to housing selected applicants for the senior posts.

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"A" & "B" and "A" & "C" Licensed Engineers with Dakota/Pratt & Whitney endorsements required by British firm in Mediterranean area. Viking/Hercules and/or other endorsements considered an advantage. Hangar maintenance and C of A overhaul experience desirable. Also "X" Licensed Electrical Engineer with workshop and hangar experience on Dakota aircraft and equipment. Viking and/or Viscount experience considered an advantage. Good salary and allowances, U.K. leave, furnished accommodation for married man, free air passages. Apply B.E.A. Associated Companies' Liaison Office, Dorland Hall, Regent Street, S.W.1. [3766

PRODUCTION Manager. Senior aircraft executive is required to fill the above position. Applicants should have had first-class experience in all aspects of production control, workshop techniques and modern manufacturing methods. It is imperative that applicants should be holding a similar position and seeking advancement. The successful candidate will be expected to reside in the Midland area and the appointment will carry a salary commensurate with the duties and responsibilities involved and is pensionable. Write giving qualifications, details of experience and salary required to Box F.516, L.P.E., 55 St. Martin's Lane, W.C.2. [3777

ASSISTANT Chief Designer required by long established Aircraft Company opening a design department in the West End of London. He would be responsible for a new design team engaged on a project of considerable national importance. Experience of hydraulic and electrical systems, engine installation and fuel system are of more importance than experience of structural problems, although a broad background of aircraft design would be preferable. Knowledge of hydraulic flying controls and servo design and theory would be an advantage although not essential. Age 35/45 years. Salary £1,500 to £2,000 per annum with Pension. Write in confidence, setting out full details of past experience and qualifications, to Box AC07501, Samson Clarks, Ltd., 57 Mortimer St., W.1. [3767

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TECHNICAL PERSONNEL

to work on interesting and progressive development programmes on Civil and Military Aircraft.

The scope of work covers the initial design, development and productionising of both fixed and Rotating Wing Jet Aircraft and other projects.

SENIOR and INTERMEDIATE DESIGN DRAUGHTSMEN

With structural or mechanical experience.

SENIOR and JUNIOR STRESSMEN

With Engineering Degree, H.N.C. or similar qualification.

Aircraft experience an advantage but not essential for these positions.

FLIGHT TEST TECHNICIANS

Experienced in Flight Test reduction and analysis.

These are permanent and progressive posts for the right man and promotion prospects are good.

Employment conditions are good including Pension and Life Assurance scheme.

Assistance is given in obtaining single lodging accommodation within easy reach of the works and there is the possibility of assistance with housing on long-term basis.

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The Personnel Manager,

THE AIRPORT, LUTON, BEDS.

SITUATIONS VACANT

AN Engineer is required as Assistant to Chief Inspector by leading firm in aircraft industry. Experience of aero-engine accessories, servo systems and precision components is essential, whilst knowledge of A.I.D. procedure and assembly shop practice would be an advantage. Applications, giving full details of age, education, experience and salary required should be sent to Box 3967. [3738

OPERATIONS Manager—Skyways of London invite applications for the post of Operations Manager to be responsible to the Technical Manager. Essential qualifications; good education, initiative, and wide experience of airline procedure. Must hold, or have held, A.L.T.P. on large aircraft. Post would suit very recently retired airline captain. Apply to: Personnel Manager, Skyways, Ltd., 7 Berkeley Street, W.1. [3760

SENIOR and Intermediate Design Draughtsmen with aircraft and mechanical engineering experience required. The work will interest men who can apply their design ability to the development of new equipment which has a steadily growing application. Pleasant working conditions. Pension and Insurance Schemes. Limited accommodation available. Within easy reach of Bournemouth. Special transport facilities. Apply in writing to Personnel Manager, Flight Refuelling, Ltd., Tarrant Rushton Airfield, Nr. Blandford, Dorset. [3756

BRITISH OVERSEAS AIRWAYS CORPORATION have vacancies for Engineer Officers (Flight Engineers). Applicants must be between 21 and 33 years of age, of a high standard of physical fitness and educated to School Certificate standard. The qualifications required are 5 years' experience in aircraft maintenance including both airframes and engines on four-engined aircraft or an apprenticeship in aeronautical engineering with an additional 2 years' practical experience or 2 years' experience as a Pilot or Flight Engineer on 4-engined aircraft with adequate practical experience in addition. Desirable additional qualifications are the possession of Maintenance Engineer's Licence in categories A and/or C on 4-engined aircraft and in any case applicants will be expected to have the technical knowledge necessary to obtain such licences. Successful candidates will be appointed for a probationary period which will include training to enable them to obtain the Flight Engineer's "O" Licence, and during this time a salary within the range of £625/675 per annum will be paid. On confirmation as an Engineer Officer a commencing salary of £805 per annum will be paid, rising to a maximum of £1,345 per annum. Applications should be addressed to the Chief Personnel Officer, B.O.A.C., Airways House, Great West Road, Brentford, Middlesex. [3750

GUIDED WEAPONS

The Bristol Aeroplane Company Limited at Filton offers the following appointments in the Guided Weapons Department:

(a) **FLIGHT DEVELOPMENT GROUP** Two Technical Engineers for planning a development programme. Both should have an Honours Degree in Engineering or equivalent professional qualifications. One should have experience of Automatic Control Systems and the other should have experience of Flight Development. In the latter case, specialized experience of structures and/or aerodynamics would be an asset.

(b) **A Project Planning Engineer** with sound general and mechanical engineering training and experience. An engineering degree or equivalent professional qualification would be desirable.

(c) **A Ground Equipment Engineer** with general engineering experience and qualifications together with some electronic engineering experience.

Applications, giving details of experience, qualifications and age, quoting D.O.39, should be addressed to the

Personnel Manager, The Bristol Aeroplane Company Limited, Aircraft Division, Filton House, Bristol.

SITUATIONS VACANT

LOCUST Officer (Flying duties) required by the Desert Locust Control, East Africa High Commission for one tour of 30/36 months in the first instance. Salary scale (including inducement pay and present temporary allowance of 10 per cent) £772 rising to £1,122 a year. Hard living and flying duty allowances payable. Outfit allowance £30. Free passages and liberal leave on full salary. Gratuity of 13½ per cent of total basic salary and inducement pay drawn during contract. Candidates must possess a current commercial or private pilot's licence. Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M3A/35279/PE. [3768

SITUATIONS WANTED

COMMERCIAL Pilot, 5,500 hours, instructor's rating, instrument rating and R.T. licence, Dakota, Anson, Consul, Rapide, Auster and Tiger Moth endorsed in Group 1, seeks employment with any company anywhere. Reply to Box 4147. [3782

COMMERCIAL Pilot, R.T. and instrument rating. 730 hrs. Twin and single engined experience, age 26, British, Seeks position—any country. Phone Locksheath (Hants) 3262. Alternative Bexhill-on-Sea 976. Write: Evergreen, Locksheath Park Road, Locksheath, Nr. Southampton, Hants. [3759

BOOKS, ETC.

SALE: "Flight", "Aero", "Areoplane", 1909-1916. Lambert, 347 Gertrude Rd., Norwich. [3753

FOR disposal: assorted aeronautical literature. Further details, 42 Station Road, Dodworth Barnsley. [3765

66 VOLUMES Journal R.Ae.S., January, 1945, to July, 1950, 25/-. London. Phone Streatham 8254. [3770

GUIDED WEAPONS

PROJECT DESIGN

The Guided Weapons Department of The Bristol Aeroplane Company Limited at Filton invites applications from qualified Engineering Designers for appointment to the following posts:—

(a) **DEPUTY PROJECT DESIGNER (AIRFRAMES)**

Applicants should possess high academic or professional qualifications in aeronautical engineering and should have had considerable experience of the design of airframe structures, including recent experience of high speed aircraft or missiles.

(b) **DEPUTY PROJECT DESIGNER (GROUND EQUIPMENT)**

Applicants should possess good academic or professional qualifications in mechanical engineering, and should have had a great deal of design experience of fabricated structures and mechanisms, such as medium ordnance equipment, road transport vehicles, or large-scale agricultural equipment.

Both appointments are of monthly staff status and carry a good starting salary, according to qualifications and experience.

They offer every prospect for advancement in a new and rapidly expanding field of engineering, and the guarantee of a permanent and pensionable employment, which only a large and well-established organization can give.

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Housing assistance can be given in special cases.

Write stating age, qualifications and experience to:
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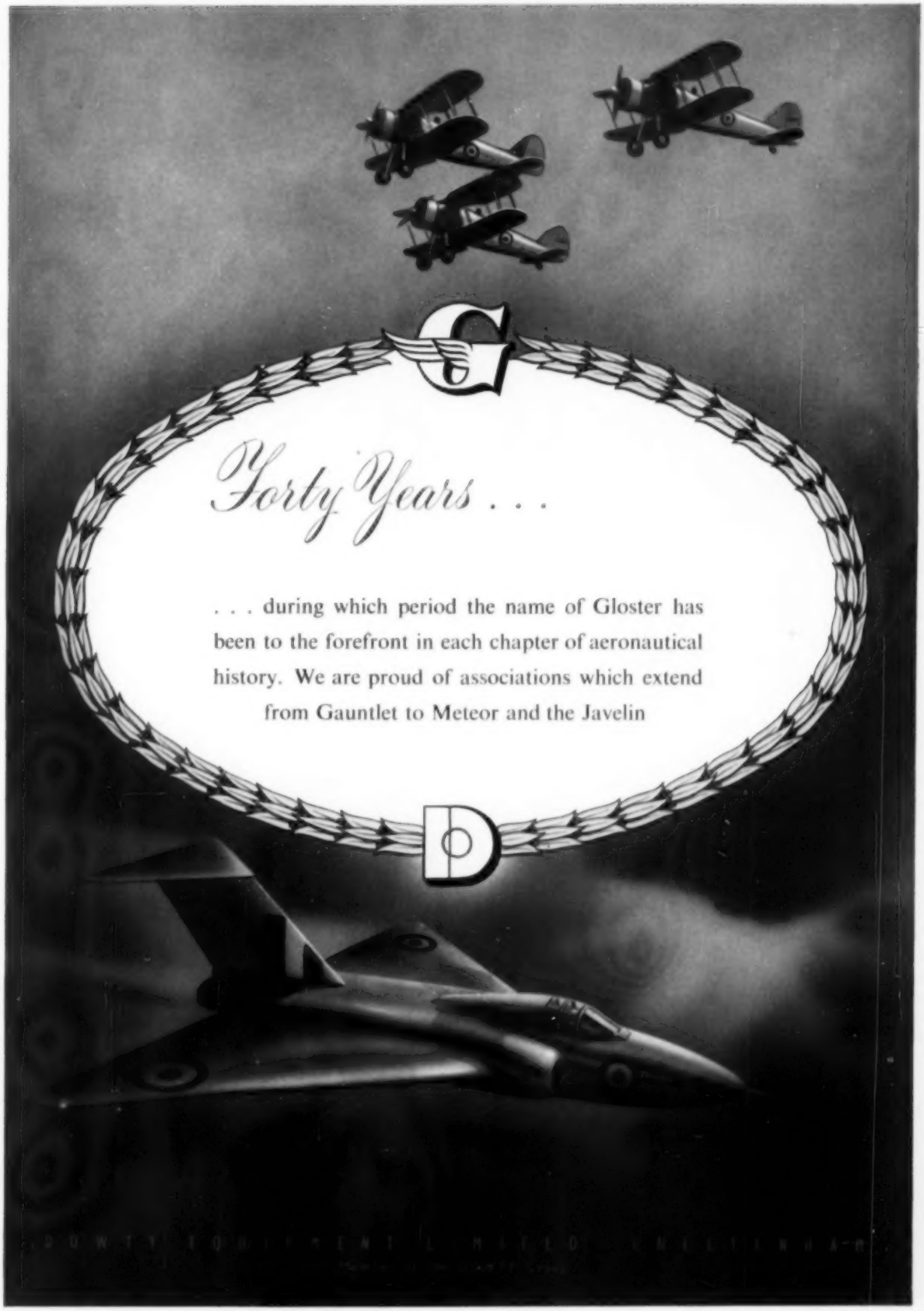
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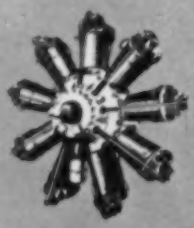

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